AMERICAN ENGINEER AND RAILROAD JOURNAL.

SEPTEMBER, 1899.

CONTENTS.

ILLUSTRATED ARTICLES:	Page
Corrugated Firebox Boiler	279
Ten-Wheel Freight Locomotives, U. P. Ry	282
Consolidation Locomotives, Santa Fe Pacific	284
Sweeney Air Compressor	287
50-Foot Furniture Cars, B. & O. S. W. Ry	288
Ten-Wheel Passenger Locomotives, D. & R. G. Ry	293
McLaughlin's Flexible Steam Conduit	297
Air Spring Pressure Regulator	298
Shafts, Hollow and Solid	299
Firebox Lagging for Locomotives	300
A. B. C. Journal Bearing	301
Ramsdell's Air Brake Piston Packing	302
Southern Pacific Steel Brake Beam	302
Improvements in Piston Valves	303
Richmond Locomotive for Sweden	304
Pressed Steel Fire Door	305
Self Feeding Saw Table	306
Whitelaw Boring Machine	306

MISCELLANEOUS ARTICLES:	
Steel vs. Wood For Water Tanks	280
Speed of Freight Trains	284
Westinghouse Brakes in Russia	284
Soda Ash in Locomotive Boilers	286
New York State Canals	286
Brake Control of Double Headers	287
Vacuum Steam Heating	289
Table of Heating Surfaces	292
Present Demand for Steel	293
Cost of Handling Freight	298
Using the Technical Papers	298
Test of an Otto Gas Engine	299
Flanged vs. Bald Driving Wheel Tires	300
Piecework, Intercolonial Railway	301
Stereopticon in Education of Employees	305
Reamed Holes for Rivets	306
Books and Pamphlets	307
EDITORIALS:	
Coupler Specifications and Guarantees	294
Does Winter Weather Affect Locomotive Coal Consumption	294
Pennsylvania R. R. Pension System	295

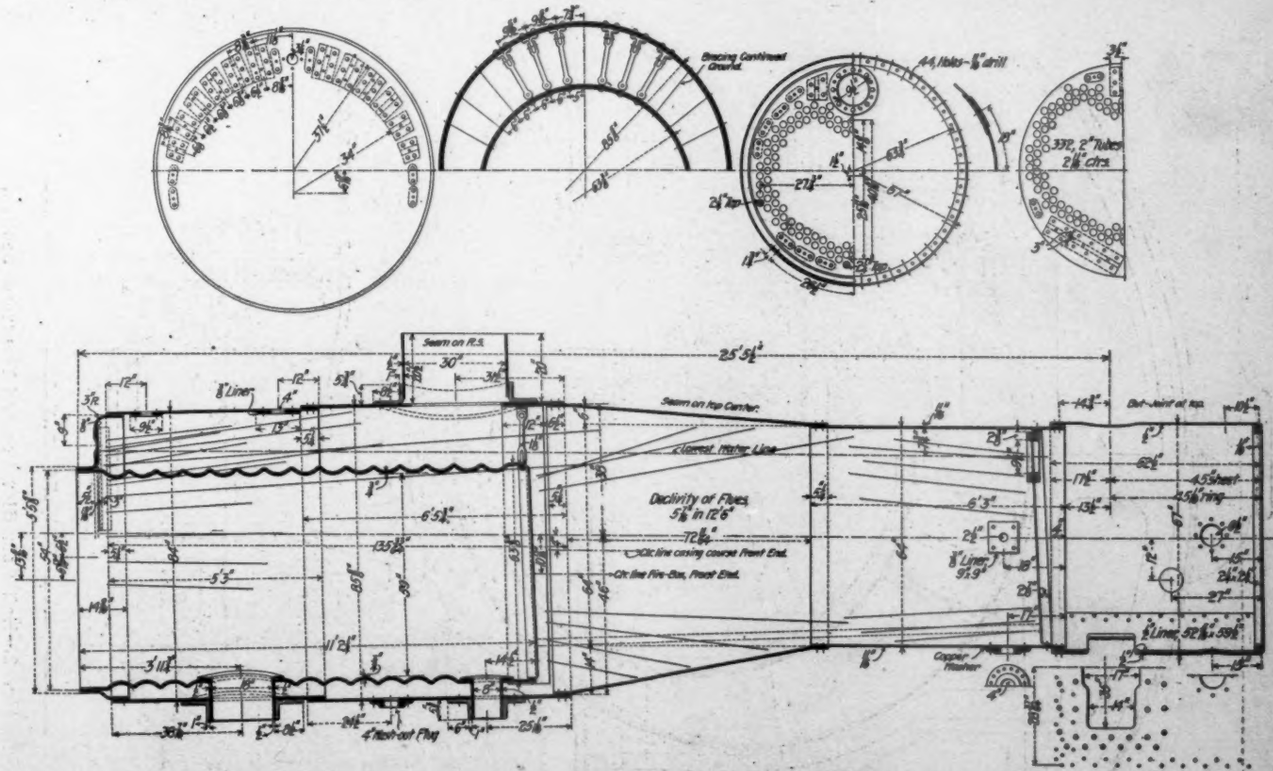
CORRUGATED FIREBOX BOILER.

New York Central & Hudson River Railroad.

A corrugated firebox of the marine type, made by the Continental Iron Works of Brooklyn and well known as the Morison Suspension Furnace, has been applied to a ten-wheel freight locomotive of the New York Central & Hudson River R. R., according to drawings made by Mr. Cornelius Vanderbilt, Jr. Several attempts have been made to use this type of furnace in locomotive practice, and while the idea is not new, this application is interesting, because of the opportunity for testing the merits of stayless fireboxes on a locomotive in such a way as will permit of making comparison with modern examples of the usual type. This boiler is somewhat like that of Lentz, which was described in the "Railroad and Engineering Journal," April, 1890, page 159. Pohlmeyer also designed one of this kind, which was described in that journal, June, 1889, page 272. This new furnace is much larger than Lentz used and is very much larger than those used by Strong in his double firebox boiler, which is so well known and has proved to be very powerful.

The locomotive is the same in general dimensions as the one illustrated on page 255 of our August issue. The cylinders are the same and also the running gear, except the driving wheels, which are 61 inches in diameter in the one with the corrugated firebox. The weight on driving wheels is 113,000 lbs., and the weight on the truck is 44,700 lbs., making the total weight 160,000 lbs. The grate area is 34 square feet and the heating surface is 2,356 square feet, of which the tubes furnish 2,164 square feet. This grate area is due to the fact that this furnace is the largest that the manufacturers have ever rolled. The locomotive was built at the West Albany shops of the road. It was begun under the superivision of Mr. Wm. Buchanan, formerly Superintendent of Motive Power, and has just been finished.

The firebox diameter inside is 59 inches and its length is 11 feet 2¼ inches, its thickness being ¾ inch. It was tested at the works of the manufacturers with hydraulic pressure of 500 lbs. per square inch, applied externally, which caused a distortion of less than one sixth hundredth of an inch. The method of securing the firebox in place and the arrangements of the tube sheet and the back head are shown in Fig. 1. This view also shows the two flanged thimbles through the furnace. The front one is 8 inches in diameter, placed 14 inches from the front end, and the other, which is for the removal of ashes, is 18 inches in diameter and is located about 4 feet from the back head. The front thimble is covered by a hood somewhat re-



Experimental Corrugated Firebox Boiler Designed by Cornelius Vanderbilt, Jr.
New York Central & Hudson River Railroad.
Fig. 1.—Longitudinal and Transverse Sections.

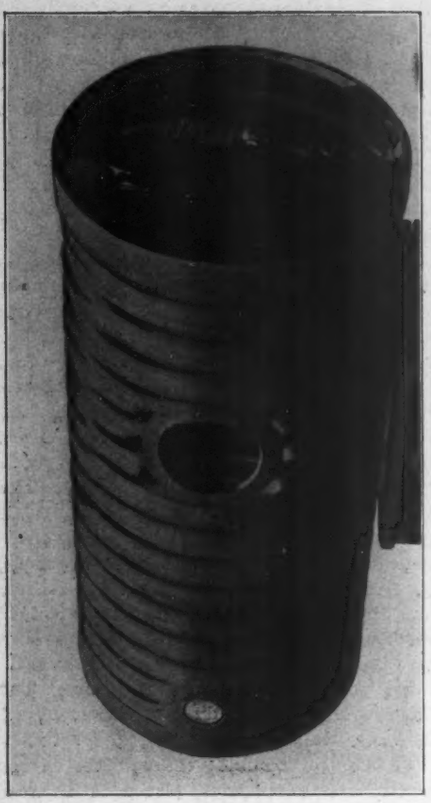


Fig. 4.—Corrugated Firebox.
Made by The Continental Iron Works, Brooklyn, N. Y.

sembling a cinder pocket, while the larger one opens into the ash pan. The length of the boiler from the back end to the center of the cylinders is 25 ft. 5½ in. The diameter of the first course of the boiler is 64 inches. The tubes, 332 in number, are 2 inches in diameter, 12 ft. 6 in. long and are set with a slope of 5 7/16 inches in their length.

There are two fire doors, which are of pressed steel, the present standard of the road. The grate bearers are wide and the location of the grates is seen in Fig. 2. The ash pan is 25 inches wide and extends between the driving axles, as shown in Fig. 3. A perforated damper closes the lower part of the furnace front, these holes being about 24 in number and 1½ inches in diameter. The furnace has a bridge wall, not shown in the engravings, which divides the space and permits of using the front end of the furnace as a combustion chamber.

This locomotive has been running about two weeks and is reported to have satisfactory steaming qualities. It is in use on the Mohawk Division in freight service and appears to be doing its work well, as compared with other engines of about the same weight having the usual form of firebox. It will require quite a long period of service to develop the relative advantages. The experiment seems likely to be successful, at least there seems to be no reason why it should not succeed, and every encouragement should be given to any attempt to get around the present stay-bolt difficulties. This type of furnace is so eminently successful in marine practice as to give good grounds for hope that it may be used on locomotives. No one can say what the locomotive boiler of the future is to be and no one will say that it will not be an improvement upon present practice.

STEEL VS. WOOD FOR WATER TANKS.

The relative advantages of steel and wood for the construction of water tanks for locomotive water stations were discussed by Mr. T. W. Snow in a paper recently read before the Western Society of Engineers. Mr. Snow, from a wide experience, has found the life of wooden tanks to be from 20 to over 30 years, and he believed that unless unusual precautions were used, steel tanks would not last as long as wooden ones

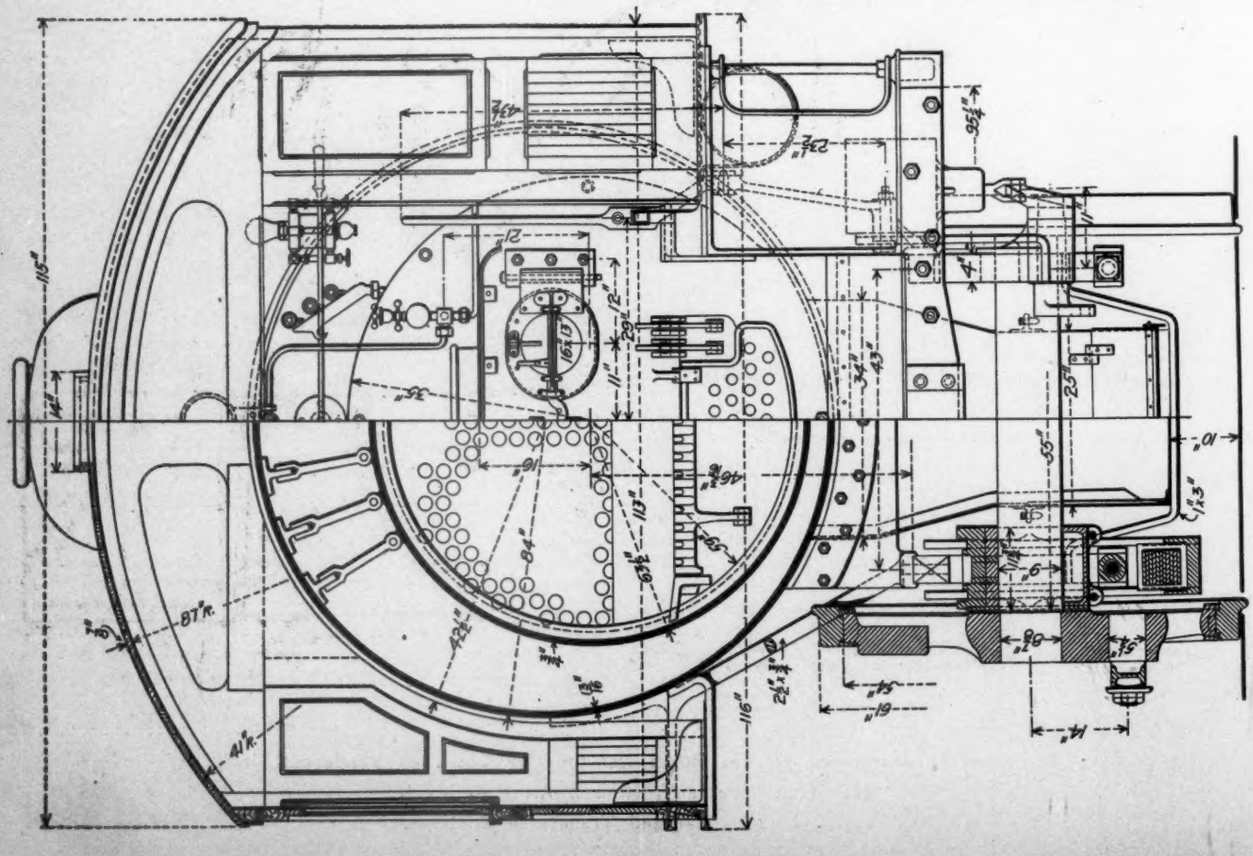


Fig. 2.—Half Rear Elevation and Transverse Section.

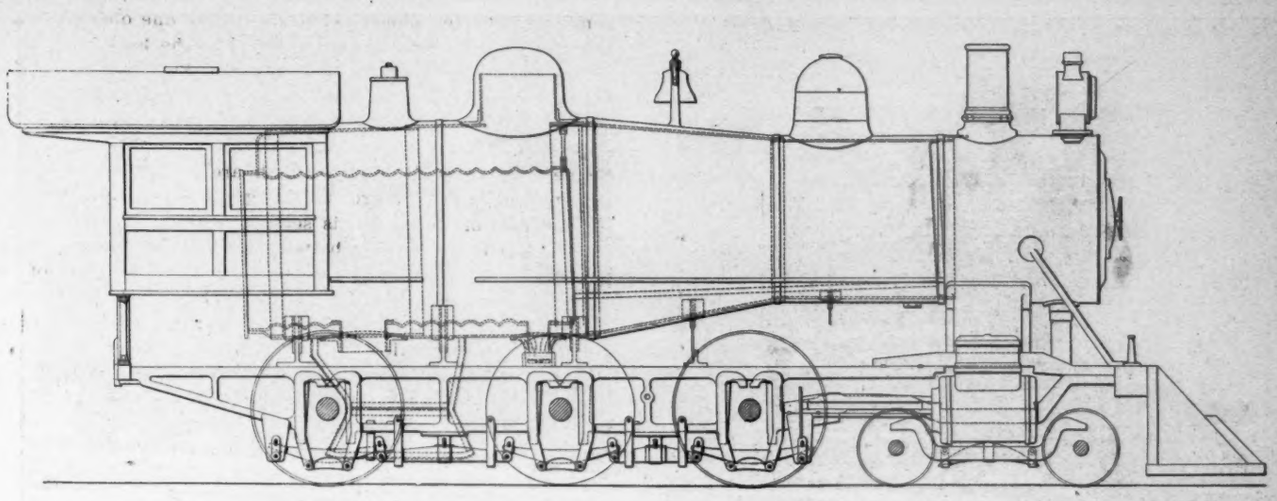


Fig. 3.—Corrugated Firebox Boiler.

New York Central & Hudson River Railroad.

made of properly selected lumber. Size has much to do with the cost, however, and for capacities of more than 100,000 gallons wood could not be used. Mr. Snow expects to see tanks made of large diameter and less height than are now customary. The increased cost of pumping into high-sided tanks is worthy of consideration, and the danger of freezing is less in tanks of larger diameter. Steel tanks appear to have gained popularity recently, but the present high price of steel is likely to increase the favorable opinion of wooden ones.

In discussing Mr. Snow's paper, Mr. Onward Bates, Superintendent of Bridges and Buildings of the Chicago, Milwaukee & St. Paul Railway, expressed his interest in the subject and stated that he had recently figured on installing some steel tanks, but was deterred by their high cost compared to wooden ones. His remarks were in part as follows:

"It is true that a wooden tank ought to last 20 years. I know of some wooden tanks which are at least 30 years old, and also of some which fell down as the result of trying to carry them too long.

"Failures which I have noticed were due to failure of the hoops, weakened by rusting, in some instances, and in other instances tanks fell down in consequence of rotten supports. I think Mr. Snow is right that a good wooden tank will last as long as two sets of hoops, and it is my practice to put additional hoops on all tanks that are getting old. My trouble has been with hoops rusting on the side next to the tank, and it is difficult to inspect such hoops, as the outside, when kept painted, may be reasonably free from corrosion, while they are nearly rusted through from the inside.

"The staves and bottom of a wooden tank will last indefinitely if the tank is kept full of water, but conditions are not so favorable in this respect as formerly. At many water stations the increased train service causes such a demand on the water supply that it is not possible to keep the tank full of water, and when this is the case, the upper ends of the staves soon show decay. I think a wooden tank should last twice as long as the wooden frame which carries it.

"The chief trouble in building wooden tanks is in getting good timber. We still use white pine, but this, if in any degree clear and free from sap and knots, is expensive. The kind of white pine we would like to use, that is, clear white pine, may run up in cost to $40 a thousand. We do not spend, perhaps, more than $16 per thousand for tank lumber.

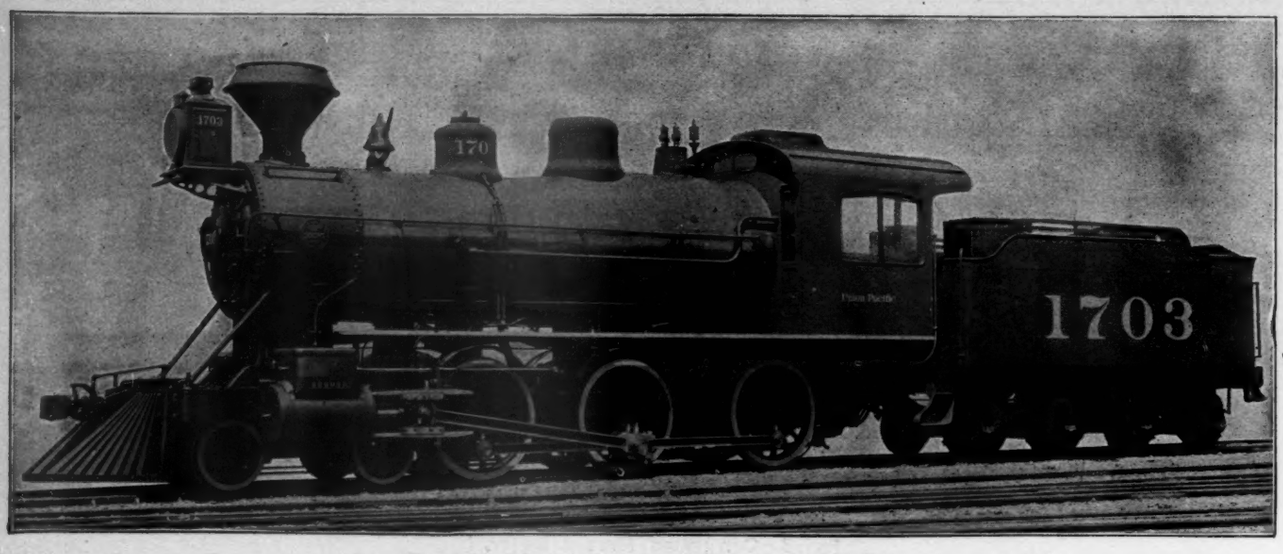
"While wooden tanks are subject to decay, steel tanks are not free from corrosion. Railroads must of necessity use all kinds of water that is not at all usable, for in many localities good water is not to be obtained, and the kind of water which penetrates 3-inch pine staves and eats up the hoops of a wooden tank must be severe on a steel tank. With such water I question if a steel tank will outlast a wooden one. The quantity of water to be supplied will determine the economical solution of the question of 'Wood vs. Steel Tanks,' and with growing demand for larger supplies more steel tanks will be used. These are already growing in favor on some of our railroads, and it will not be long before we have practical knowledge of their suitability for such service. We may also hope that the price of steel will again fall to where it will admit of competition with wood."

The train staff was the subject of a paper read by Mr. W. J. Murphy, superintendent of the C. N. O. & T. P. Railway, before the Central Association of Railroad Officers at the recent St. Louis meeting. He described the divided train staff as it is used on that road near Cincinnati. One-half of the staff is given to the engineer and the other half to the conductor. There are 31 staffs in the two instruments and one of these forms the key for unlocking the tablet box containing six permissive tablets; this feature, however, is not used for passenger trains and its use is always under the control and direction of the superintendent. A semaphore is used in connection with the staff to govern admission into the staff station, and the signaling circuits are controlled by the semaphore in such a way as to cut out the signal communication except when the signal is in the horizontal or stop position. A special form of dispatcher's order is used in case of failure of the staff apparatus. This is an absolute block order and gives rights over all other trains.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.

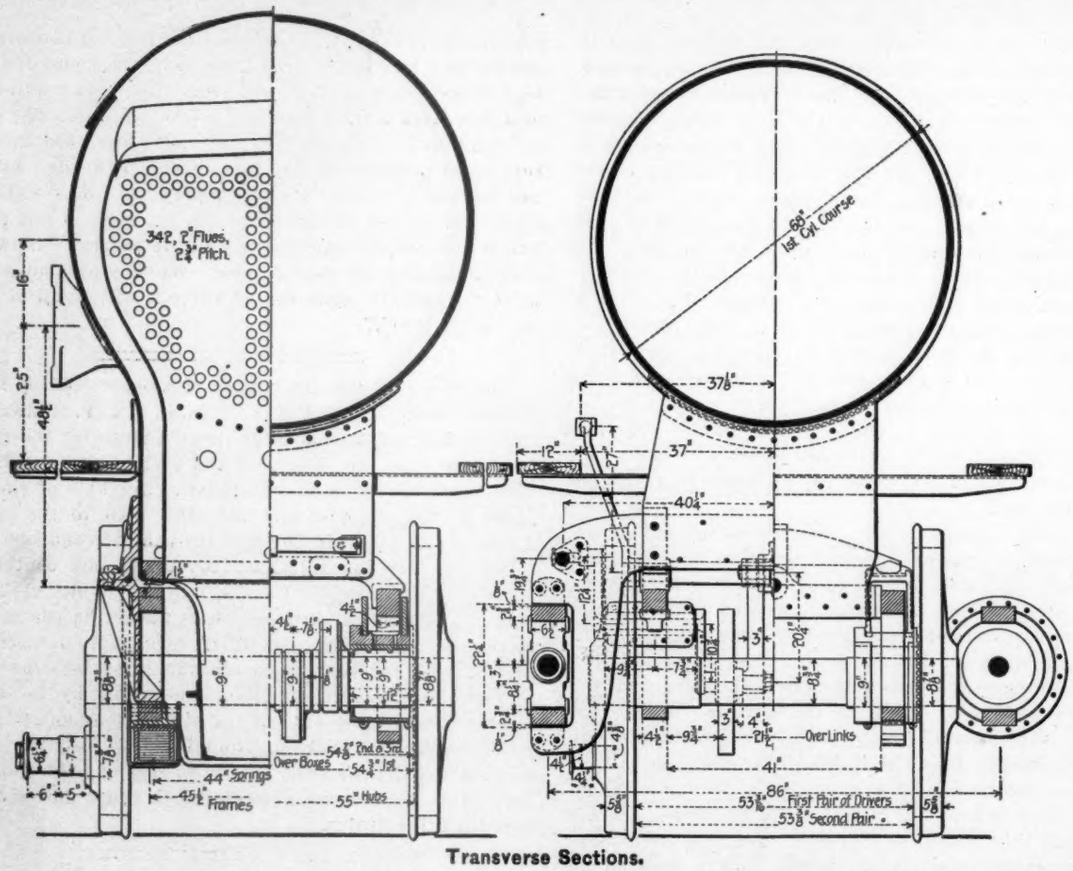
The thirtieth annual convention of the Master Car and Locomotive Painters' Association will be held at Philadelphia, Pa., on the 12th, 13th, 14th and 15th of September, 1899, convening at 10 o'clock A. M., on Tuesday, the 12th, at the Continental Hotel (located at Ninth and Chestnut streets, opposite the U. S. Government Building and Post Office), which has been chosen as the official headquarters of the Association.

The Association extends a general invitation to all Foremen Car and Locomotive Painters in the States and Canada to meet with them in convention and participate in the discussions which will come forward during the session on many important questions in connection with Car and Locomotive Painting.



Ten-Wheel Freight Locomotive—Union Pacific Ry.

MR. J. H. MCCONNELL, *Superintendent Motive Power.* BROOKS LOCOMOTIVE WORKS, *Builders.*



Transverse Sections.

TEN-WHEEL FREIGHT LOCOMOTIVES.

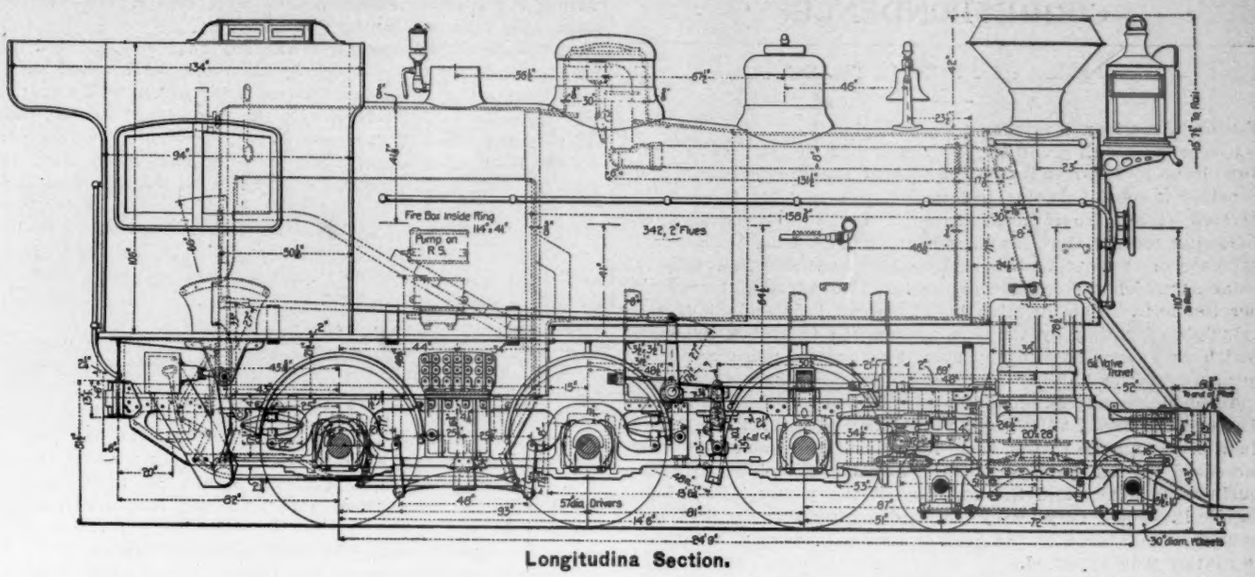
Union Pacific Railway.

Brooks Locomotive Works, Builders.

Through the courtesy of Mr. J. H. McConnell, Superintendent Motive Power of the Union Pacific Railway and the Brooks Locomotive Works, we illustrate and describe one of forty ten-wheel freight locomotives which have just gone into service on that road.

The total weight of the engine is 170,000 pounds, with 134,000 pounds on the driving wheels. The cylinders are 20 by 28 inches; the driving wheels 57 inches diameter, of cast steel; the driving journals are 9 by 12 inches; the boiler is of the crown bar type, the diameter of the barrel being 68 inches, and that of the back head 76¾ inches. The heating surface is 2,574 square feet, which, by the way, is only 67 square feet more than that of the 8-wheel passenger locomotive for the Chicago & North Western Railway (American Engineer, July, 1899, page 224). The firebox is 114 inches long by 41 inches wide, giving 31.3 square feet of grate area.

These locomotives have the diamond stack arranged on the



Longitudina Section.

plan shown in Fig. 16 of our May issue, page 161, this form being the standard practice of the Union Pacific. All of the driving wheels have flanged tires, this practice having been followed by Mr. McConnell for some time with satisfactory results. The crosshead is of the two-bar type. The spring rigging uses a 44-inch spring across the engine for the forward drivers, with a strong brace between the frames to support the fulcrum. The main and rear drivers are equalized by means of 48-inch springs placed below the frames, attached to curved levers passing over the driving boxes by means of links 17 inches long, and the frame connections are made through short elliptic springs. The cross section shows the arrangement of the valve gear, which is somewhat like that used by these builders for locomotives with piston valves, the rocker arms being upon the opposite ends of the rocker shafts, which are hollow. The main crank pins are enlarged where they enter the wheels, but those of the other driving wheels are reduced, as are also the wheel fits of the driving axles. The driver brakes are the American and the New York Air Brake Company's apparatus, including the air pump, are used for the engine, tender and train. These engines have Fox pressed steel tender trucks. The leading characteristics of the design are given in the following table:

GENERAL DIMENSIONS.

Description.	
Gauge	4 ft. 8½ in.
Kind of fuel to be used	Bituminous coal
Weight on drivers	134,000 lbs.
Weight on trucks	36,000 lbs.
Weight, total	170,000 lbs.
Weight tender, loaded	110,000 lbs.

General Dimensions.	
Wheel base, total, of engine	24 ft. 9 in.
Wheel base, driving	14 ft. 6 in.
Wheel base, total, engine and tender	52 ft. 4½ in.
Length over all, engine	38 ft. 6⅜ in.
Length over all, total, engine and tender	62 ft. 9⅞ in.
Height, center of boiler above rails	9 ft. 2 in.
Height of stack above rails	15 ft. 7½ in.
Heating surface, firebox and arch flues	231 sq. ft.
Heating surface, tubes	2,343 sq. ft.
Heating surface, total	2,574 sq. ft.
Grate area	31.3 sq. ft.

Wheels and Journals.	
Drivers, number	6
Drivers, diameter	57 in.
Drivers, material of centers	Cast steel
Truck wheel, diameter	30 in.
Journals, driving axle	9 in. x 12 in.
Journals, truck	5½ in. x 10 in.
Main crank pin, size	6¼ in. x 6 in.

Cylinders.	
Cylinders	20 by 28 in.
Piston, stroke	28 in.
Piston rod, diameter	4 in.
Main rod, length, center to center	9 ft. 9 in.
Steam port, length	18½ in.
Steam ports, width	1⅝ in.
Exhaust ports, length	18½ in.
Exhaust ports, width	2¾ in.
Bridge, width	1⅝ in.

Valves.	
Valves, kind of	Allen-Richardson
Valves, greatest travel	6¼ in.
Valves, outside lap	1⅛ in.
Valves, inside lap	None
Lead in full gear	1/16 in. negative

Boiler.	
Boiler, type of	Crown bar wagon top
Boiler, working steam pressure	200 lbs.
Boiler, thickness of material in barrel	¾ in.
Boiler, thickness of tube sheet	¾ in.
Boiler, diameter of barrel	68 in.
Dome, diameter	30 in.

Firebox.	
Firebox, type	Over frames
Firebox, length	114 in.
Firebox, width	41 in.
Firebox, depth, front	79 in.
Firebox, depth, back	79 in.
Firebox, thickness of sheets	Tube, ⅝ in.; sides, ⅜ in.; top, ⅜ in.; back, ⅜ in.
Firebox, brick arch	On water tubes
Firebox, mud ring, width	4 in.
Firebox, water space at top	Back, 5 in.; sides, 6½ in.; front, 4 in
Grates, kind of	Cast iron rocking
Tubes, number of	342
Tubes, material	Charcoal iron
Tubes, outside diameter	2 in.
Tubes, length over tube sheets	13 ft. 2⅜ in.

Smokebox.	
Smokebox, diameter, outside	71 in.
Smokebox, length from flue sheet	53 in.

Other Parts.	
Exhaust nozzle, single or double	Double
Exhaust nozzle, diameter	3 9/16 in.
Exhaust nozzle, distance of tip below center of boiler	27½ in.
Netting, wire or plate	Wire, in top of stack
Netting, size of mesh or perforation	3 x 4
Stack, straight or taper	Diamond
Stack, diameter	16¼ in.
Stack, height above smokebox	42 in.

Tender.	
Type	8-wheel, Wood frame
Tank, capacity for water	5,000 gal.
Tank, capacity for coal	12 tons
Type of under frame	Oak
Tpye of springs	Double elliptic
Diameter of wheels	33 in.
Diameter and length of journals	5 in. x 9 in.
Distance between centers of journals	5 ft. 3 in.
Diameter of wheel fit on axle	6¾ in.
Diameter of center of axle	5¾ in.
Length of tender over bumper beams	23 ft. 0 in.
Length of tank	20 ft. 0 in.
Width of tank	9 ft. 10 in.
Height of tank, not including collar	56 in.

A radical change is being made in the appearance of the baggage, mail and express cars on the Baltimore & Ohio Railroad. The platforms and hoods are being removed to increase the element of safety and save weight. The favorite riding place of tramps is also eliminated when the platforms are removed. General Manager Underwood has also issued an order to remove the numbers from locomotive tenders, so that in cases of emergency, those of the same style will be interchangeable.

CORRESPONDENCE.

SPEEDS OF FREIGHT TRAINS.

Editor "American Engineer":

I have read with great interest the article on page 206 in your June issue by Mr. Henderson, on Freight Traffic Economics, and consider it most valuable and timely, not only for the results arrived at but from the attention it draws to the danger of following too far the reasoning that demonstrates a continual decrease of expense with increase of tonnage and indicating a point at which increased tonnage leads to additional expense per ton mile. This question is, of course, independent of the principle of rating by tonnage as opposed to rating by cars, which has been certainly proven by far the more accurate measure of the hauling power required, and in consequence enabled higher average loads to be pulled at any desired speed. There is, however, very great probability that with the introduction of tonnage rating, train loads have on some roads been increased beyond the most economical point, especially so when business is heavy and the capacity of the power is taxed to handle it. These very heavy trains, dragging over the division, have been a source of far greater loss than saving, although the latter was expected.

Referring to Mr. Henderson's article, it appears to me that he has made his calculations in a manner that is rather less favorable to the higher speed than is actually the case, for the reason that he has omitted to make any allowance for the extra time that the cars are engaged in hauling one ton one mile at the lower speeds. This is certainly as important as the interest and depreciation allowed in the case of the engine and is at least necessary to represent the difference in the earning capacity per car if hauled at 5 or 15 miles per hour. As in the case of the locomotive, this is, in busy times, scarcely accounted for by 5 per cent. on the capital invested, but ideal cases must, of course, be assumed for purposes of argument, and, if all cars were considered loaded, the capital involved would approximate $10 per gross ton, an amount comparable with the value of the engine and which would cheapen the relative cost of the higher speeds. The speeds above 10 miles per hour have been given an advantage in the case of many roads by the fact that the wages have been put on an hourly basis. If paid by miles when in excess of hours, these would not decrease per mile as the speed increased, and if paid by the trip the same thing would hold true.

On the whole the article appears to be a strong endorsement of the practice of not allowing tonnage to be hauled that necessitates an increase of time over ten miles per hour, and it is most valuable as elucidating the reasons which render such practice successful. GENERAL SUPERINTENDENT.

Chicago, August 10, 1899.

WESTINGHOUSE BRAKES IN RUSSIA.

Editor "American Engineer":

Statements have been published to the effect that the New York Air Brake Company has secured portions of the large orders for air brake equipment for the railroads of Russia, to be filled during the next three and a half years. In reply to your inquiry as to what we can say in reference to this matter we are glad to make the following statement:

It was not until negotiation with the Russian Government had proceeded so far that the business of supplying the brake apparatus for the Imperial State Railways was practically assured to us, that the Russian Company was established and the construction of a manufacturing plant was begun.

About the end of last year, we secured from the Russian Government an order for about $2,000,000 worth of air brake material for the State Railways. During January of the present year a congress of representatives of the rolling stock departments of all the private as well as the Government railways was called, and, after extended deliberation, the Westinghouse quick-action air brake system was adopted as the standard for all railways, private and state.

On the 5th of June, an imperial decree was issued which announced and ordered that:

(1) All freight locomotives and tenders, and a sufficient number of freight cars to secure brake control of all freight trains within the Russian Empire, must be equipped with air brake apparatus prior to January 1st, 1903;

(2) The Westinghouse air brake has been adopted and must be purchased for this purpose by all roads, private and state;

(3) The use of any other kind or make of air brake than the Westinghouse is prohibited, with the provision, however, that a trial of any other brake system may be made, in connection with the Westinghouse, upon local trains. Each such trial must be conducted, under the direction of the Imperial Brake Commission, for a period of at least three years, after which the suitability of the brake so tried must be considered by a congress of rolling stock representatives of all the railways, and the conclusians of this congress must thereafter be submitted to Imperial ratification before any such brake can be used in general service.

In view of the facts above stated, it will be perfectly clear that any statement to the effect that we have not secured the Russian air brake business, or that the New York Air Brake Company has secured or can secure any portion of the enormous air brake business during the next three and one half years in the Russian Empire, is and must be entirely without foundation. The use of the New York Air Brake Company's apparatus is not only not contemplated upon any railroad in Russia, but is expressly prohibited for at least three years to come, except for experimental purposes upon local trains, under the permission and direction of the Imperial Brake Commission.

We have in our possession a translated copy of the Imperial decree of June 5th, which we shall be pleased to submit to your perusal in verification of the above statements.

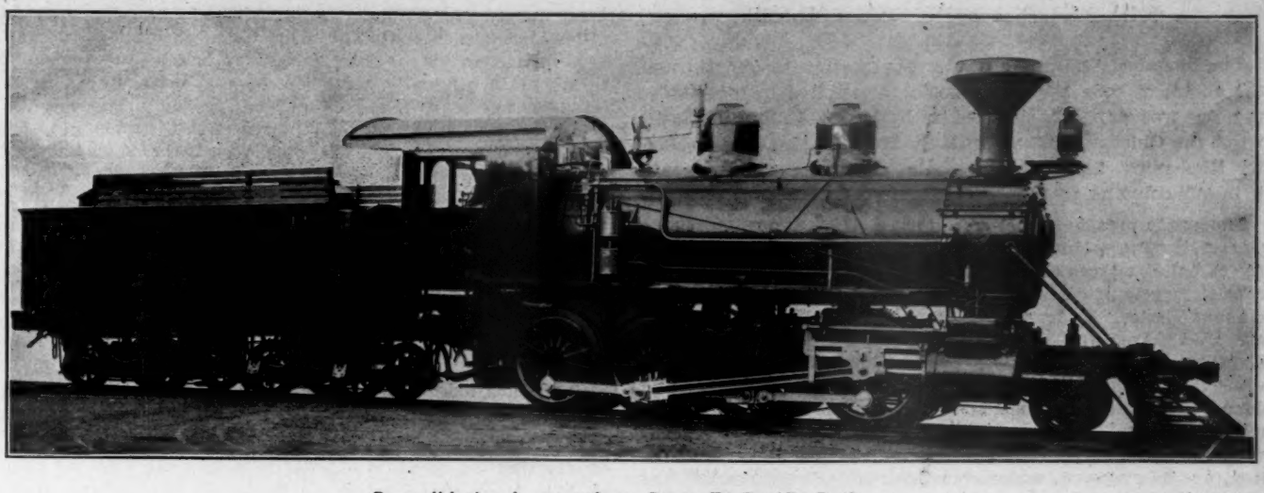
It gives us pleasure to add that the demands for the output of our Russian plant, to comply with the requirements of the Imperial decree, necessitates its immediate enlargement to double its present capacity, and we have taken steps in that direction. It is estimated that we shall be required to supply air brake fixtures for about 350 locomotives and tenders and 1,750 freight cars, per month, during the next three and a half years.

THE WESTINGHOUSE AIR BRAKE CO.,
H. H. Westinghouse, General Manager.

Pittsburgh, July 28, 1899.

The relatively large average train load of 425 tons is reported by President Ingalls of the Chesapeake & Ohio for the year ending June 30, 1899. The average train load for this road in 1897 was 259 tons, and it has risen steadily until it has reached the high figure given. It is stated that for the year ending in 1898 the New York Central reported an average train load of 299 tons, the Erie 300, the Lake Shore 352, the Great Northern 316, the Baltimore & Ohio 314 and the Norfolk & Western 355 tons.

The change from steam to electric traction on the Manhattan Railway of New York City has been started by the beginning of work on the new power house between 74th and 75th Streets on the East River. This power house will provide for the largest collection of steam and electrical machinery ever united in a single plant, and is particularly interesting because of the large power units which are to be used. The aggregate power of the plant when pushed to its limit of capacity will be nearly 100,000 horse power, and the units will be of 8,000 horse power each at their rated capacity, but each is to be capable of carrying a 50 per cent. overload for continuous service. The selection of these large units has caused comment among steam engineers merely on account of their size, because a breakdown or temporary disability of one of the engines will deprive the plant of the use of such a large amount of power. In this case, however, the units are no larger in proportion to the total size of the plant than are ordinarily found in smaller power houses. This fact does not detract from the interest in this installation, which is a remarkable one in every way. The boiler plant is also the largest ever assembled in one place and the order for the boilers, which is mentioned elsewhere as having been given to the Babcock & Wilcox Company, is the largest single order for boilers which has ever been placed.



Consolidation Locomotives—Santa Fe Pacific Railway.

DICKSON LOCOMOTIVE WORKS, *Builders.*

CONSOLIDATION LOCOMOTIVES.

Santa Fe Pacific Railway.

Dickson Manufacturing Company, Builders.

The Dickson Manufacturing Company have completed 10 consolidation locomotives for the Santa Fe Pacific in accordance with specifications furnished by Mr. John Player, Superintendent of Motive Power of the Atchison, Topeka & Santa Fe Railway.

Cast steel has been used extensively in these engines, the principal parts made of this material being the frames, driving boxes, steam chests and covers, driving wheels, equalizers, guide yokes and quide yoke brackets, brake hangers, cross heads, rocker arms, tumbling shafts, reverse levers, pedestals, radius bars and other smaller parts.

The engines have extended piston rods, Mr. G. A. Hancock's design of pilot coupler, which is adjustable in height to suit varying heights of pilots, the Rushforth feed water heater, and the Sweeney air brake attachment. Four pneumatic blow-off cocks are provided, three in the water legs and one under the barrel of the boiler. The crown staying is Mr. Player's combination of crown bars and sling stays.

The light weight of the tender is stated to be 39,000 pounds, which corresponds to the 5,000 gallon tank formerly used. The tanks on these tenders carry 6,000 gallons, the frames being lengthened two feet to accommodate them. The tank projects over the frame for the purpose of carrying condensation and other water free of the frames.

The chief dimensions of the engines are presented in the following table:

Type	Consolidation
Gage	4 ft. 8½ in.
Kind of fuel	Gallup lignite
Weight on drivers	140,625 lbs.
Weight on truck wheels	15,375 lbs.
Weight, total of engine in working order	156,000 lbs.
Weight of tender	light, 39,000 lbs.; loaded, 110,000 lbs.
Cylinders	21 by 28 in.
Wheel base, total of engine	23 ft. 3 in.
Wheel base, driving wheels	15 ft. 2 in.
Height, center of boiler above rail	8 ft. 2½ in.
Height, stack above rail	15 ft. ¼ in.
Heating surface firebox	153.6 sq. ft.
Heating surface tubes	1687.2 sq. ft.
Heating surface, total	1840.8 sq. ft.
Grate area	29.25 sq. ft.
Drivers, diameter	57 in.
Truck wheels, diameter	30 in.
Truck wheels, centers	wrought-iron centers
Journals, driving axles	8 x 9 in.
Journals, truck axles	5½ in. x 10 in.
Main crank pins	6 x 6¾ in.
Cylinders	21 x 28 in.
Piston rod diameter	4 in. extension 3 in. diameter
Main rod length	123⅞ in.
Steam ports	18 x 1⅝ in.
Exhaust ports	18 x 3 in.
Bridge length	1⅞ in.
Valves, greatest travel	5¾ in.
Valves, outside lap	⅞ in.
Valves, inside lap or clearance	line and line
Valves, lead in full gear	1⅛ in. blind
Boiler, types of	straight
Boiler working pressure	180 lbs.
Boiler, thickness barrel sheets	⅝ in., throat 1 1/16 in.
Boiler, diameter barrel sheets	66¾ in., first course
Boiler tube sheets	front 9/16 in. thick, back 11/16 in. thick
Firebox crown sheets	9/16 in. thick
Firebox crown sheets	stayed with crown bars and sling stay
Firebox length	8 ft. 7 in.
Firebox width	42 in.
Firebox depth, front and back	61¾ in.
Firebox brick arch	Yes
Firebox water spaces, front, back and sides	4 in.
Tubes	Number 233 outside diameter 2 in.
Tubes, length over sheets	13 ft. 10 in.
Dome, diameter	30 in.
Smokebox, diameter inside	68 in., length 43½ in.
Exhaust nozzle	Single, short, with petticoat pipe
Exhaust nozzle, diameter	4¼ in.
Exhaust nozzle tip, distance below center of boiler	22½ in.
Stack, diamond	S. F. P. pattern, cast-iron barrel
Stack, least diameter	16 in.
Stack, height above smokebox	47 in.

Tender.

Type	A. T. & O. F., sloping top sheets in coal space
Trucks	Player cast-steel swivel arch bar trucks with cast steel rigid bolster
Tanks, capacity	Water 6,000 gallons, coal 10 tons
Tank material	Steel 5/16 in. thick top and bottom
Tank material	Steel ¼ in. thick sides
Tank, under frame	A. T. & S. F. standard steel construction
Truck wheels, diameter	33 in.
Truck axles, diameter and length journals	5 in. x 9 in.
Truck axles, distance between centers of journals	76 in.
Truck wheel base	62 in.
Truck bolster	Rigid Player cast-steel
Type of body transom	Channel
Length of tender frame	22 ft. 7½ in.
Length of tender frame over bumpers	23 ft. 10½ in.
Length of tank	22 ft. 3 in.; width, 9 ft. 6 in.
Height of tank	Under collar 59⅝ in., over collar 63½ in.

The Sweeney Air Compressor is illustrated on page 287 of this issue.

THE TRAVELING ENGINEERS' ASSOCIATION.

The seventh annual convention of the Traveling Engineers' Association will be held at the Grand Hotel, Cincinnati, Ohio, September 12, and will continue several days. Secretary Thompson states that the reports this year are unusually valuable and that a very profitable convention is assured. The motto of the association is "To Improve the Locomotive Service of American Railroads," and the past history of the organization entitles it to support and encouragement from the higher officers.

The acetylene gas plant of the Logansport and Wabash Valley Gas Co., at Wabash, Ind., exploded August 7, with destructive effect. This is the first plant installed in this country on so large a scale and has been in use about a year in lighting the city. This accident, which does not appear to have been satisfactorily explained, will tend to cause a renewal of distrust of this gas.

SODA ASH IN LOCOMOTIVE BOILERS.

The chemical features of water purification in general and the action of soda ash in particular as applied to locomotive practice was so neatly summed up by Mr. H. E. Smith, Chemist of the Chicago, Milwaukee & St. Paul Ry., before the Master Mechanics' Association recently, that we desire to record it in our columns, as follows:

The solids present in boiler waters may be divided into two classes, the incrusting and non-incrusting solids. In the majority of boiler waters of the United States the incrusting solids consist largely of calcium and magnesium carbonates, and calcium sulphates. Under the action of heat alone, the carbonates are precipitated at 212 degrees Fahrenheit and the sulphate at about 260 degrees Fahrenheit. The sulphate is much more injurious than the carbonate, because it forms a much harder and denser incrustation. Occasionally magnesium sulphate or chloride is present. These two substances are soluble in water, but when heated under pressure, especially if in the presence of iron, are decomposed, magnesium hydroxide being precipitated as incrustation, while the acid is set free, as a corrosive element. Silica, alumina and oxide of iron are generally present in small amounts and enter the incrustation.

The non-incrusting solids are the compounds of the alkalies, and are usually made up of sodium and potassium sulphates, and sodium chloride. Sodium carbonate and potassium chloride are sometimes present. None of these compounds form incrustations, but, on the other hand, cause foaming if present in large amounts. Our experiments indicate that other things being equal, the various alkali compounds are about equally efficient in producing foaming.

In actual practice, however, the carbonates produce a flocculent sludge with waters containing calcium and magnesium compounds, and on this account are indirectly more efficient than sulphates or chlorides in producing foaming.

Occasionally free mineral acid, generally sulphuric acid, is found in natural waters, and produces corrosion. Sewage, and some kinds of factory waste produce both foaming and corrosion. Suspended solids obviously produce incrustation, and sometimes foaming. When waters are treated in the boiler with soda ash, the incrusting solids are changed to carbonates and precipitated as a soft sludge, which is readily blown out, instead of coming down in crystalline condition and adhering to the surface of the boiler. Extended experience has shown that it is not necessary to use as large an amount of soda ash as the full chemical equivalent of the incrusting solids. This is of very decided advantage in boiler operation. There appear to be several reasons for this fact, as follows:

1. If no precipitant is used, all of the nominally incrusting solids do not immediately adhere to the boiler, but may be easily removed by blowing or washing.

2. When soda ash acts upon calcium and magnesium sulphates it is changed to sodium sulphate, which has no further action as a precipitant. But calcium and magnesium carbonates require for their precipitation only the absorption of the free carbonic acid gas of the water. This action leaves the soda ash in the form of bicarbonate, which, by the heat of the boiler, is gradually changed back to the normal carbonate (soda ash), which can then act upon a fresh portion of incrusting solids.

3. The flocculent sludge produced by the direct action of the soda ash doubtless incloses particles of crystalline solids which are thrown down by heat alone, thereby preventing them from adhering to the boiler.

In calculating the amount of soda ash to be used, we employ the following table of ratios, which represents present average practice:

One grain of the following salts per gallon of feed water.	Requires per 1,000 gallons of feed water, the following amounts of 58° soda ash.
Calcium or magnesium carbonate	0.02 pound.
Calcium sulphate	0.10 "
Magnesium sulphate	0.13 "
Magnesium chloride	0.16 "

The proper ratios to be employed vary somewhat according to the amount and character of the incrusting solids and the amounts of alkalis in the waters. They also vary according to the service of boilers and the care used in blowing and washing out. The ratios given are suitable for the average waters of the Mississippi Valley, for boilers which receive reasonably good care. The proportion of the soda ash specified for carbonates is only about one-seventh of the chemical equivalent. That for calcium sulphate is nearly the full equivalent, while for magnesium sulphate and chloride the theoretical amount is used on account of the corrosive nature of the salts. Some waters contain originally some sodium carbonate, in which case less soda ash is needed, or it may be entirely dispensed with.

On account of foaming, it is not desirable to use more than 10 pounds of soda ash per 100 miles, even if the calculation calls for more.

THE NEW YORK STATE CANALS.

Their Greatest Usefulness Gone.

Canals have exerted a powerful influence on the transportation interests of this country. They have tended to improve railroad methods until the cost of rail transportation is now so much below that of the canal as to place the latter in the background as an institution which has lost its influence. In considering the question of what is to be done with the canals of New York State, Governor Roosevelt invited the expression of opinion of leading men, having knowledge of the subject, for guidance in future legislation. The whole correspondence, which is very voluminous, is interesting. It develops the fact, now admitted by the men who were formerly strong advocates of the canals, that while these waterways have in the past served to keep railroad rates in check, they are now outclassed by the railroads, which, by the introduction of improved methods, have reduced the cost of transportation to as low a point as three mills per ton per mile. Thus the canal has lost its greatest usefulness, and it is not likely that large sums of money will be invested in their improvement and further development. It is probable that the canals will be maintained, but which of the first four of the following five propositions will be carried out it is impossible to predict:

First.—To complete the present project of enlarging the Erie, Oswego and Champlain Canals at a further cost of $15,000,000 (or $24,000,000 in all).

Second.—To enlarge the present locks of the Erie Canal at once to a length of 260 feet, a width of 26 feet and depth of 11 feet, making them suitable for boats 25 feet wide, 125 feet long and 10 feet draught. This project would cost about $6,000,000.

Third.—To construct a barge canal continuously descending all the way to the Hudson River from Lake Erie, with a depth of 12 feet, and suitable for barges of 1,200 to 1,500 tons, which can be towed on the lakes, if desired. The cost of this is approximately estimated at $50,000,000.

Fourth.—To construct a ship canal with a depth of 20 to 30 feet, suitable for lake and ocean vessels of 5,000 to 10,000 tons capacity. The cost of such a ship canal, depending upon its size and route adopted, is estimated at from $200,000,000 to $500,000,000.

Fifth.—To abandon the canals entirely, as has been done in some other states, and dispose of the property interests therein to private individuals or corporations on the best terms that can be secured, or to make some other use of the property for the benefit of the state.

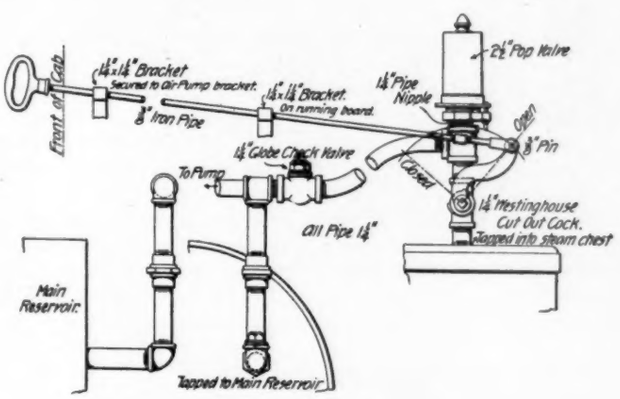
Two large, self-propelling steel dredges are to be built by the Maryland Steel Co. for the work of dredging the new channel to New York harbor. They are to be similar to those used in England on the Mersey and will cost about $450,000 each. They are to be of the suction type and will deposit the material in immense hoppers on the dredges holding 3,500 tons and will steam out to sea at a speed of 12 miles per hour to dump it. The dredges will be 320 feet long, 48 feet beam and 26 feet deep. The propelling machinery will consist of two triple expansion engines with four cylinders each, driving twin screws and the hydraulic pumping suction machinery will be driven by independent tandem compound engines. Accommodations for officers and crew will be provided, so that the dredges will work night and day. The speed of working while dredging will be three miles per hour. It is expected that the first one will be ready for service next May and the second a little later.

THE SWEENEY AIR COMPRESSOR.

This device, which is applied to the Santa Fe Pacific locomotives, illustrated elsewhere in this issue, is very well known and highly prized on some of the western roads having heavy grades, but is not used elsewhere. It is not an air compressor, but is an attachment applied to one or both main steam cylinders of the locomotive, whereby they are made to compress air into the main reservoir for temporary relief of the air brake pump. The originator, Thomas Sweeney, is a locomotive engineer on the Southern Pacific, and his purpose was to provide means for maintaining air pressure in the train pipe in case of failure of the air pump and in recharging when descending long mountain grades.

The device consists of a pipe connecting the top or side of the steam chest with the main air reservoir, the passage between the two being controlled by a stop cock at the steam chest and a check valve near the reservoir. A pop valve set to open at a pressure of 90 pounds, is mounted in the pipe and the apparatus is completed by a connection from the stop cock and the cab, whereby the engineer may open or close it.

When it is necessary to use the device, steam being shut off, the reverse lever is placed slightly back of center notch and



The Sweeney Air Compressor.

the cylinder cocks left open for three or four revolutions of the engine to allow water that may be in the cylinders to escape; then the stop cock is opened and the brake valve placed in charging position. The reverse lever must be left back of the center notch at least fifteen seconds after full pressure has been indicated on the air gauge. Before the reverse lever is moved forward the brake valve is placed on lap; and, in case the air pump is not working, the stop cock should be closed, as the pistons will draw air from the main reservoir before the check valve closes. By placing the brake valve on the lap and closing the stop cock before moving the reverse lever forward, sufficient pressure will be retained in the main reservoir ot release the brake. After the cylinders have ceased to work as air compressors the brake valve should be left on the lap at least five seconds, so that the air will have time to equalize in the train. If the air is used immediately after moving the lever ahead, there being a higher pressure in the train pipe than in the auxiliary reservoirs, air will be wasted, as the air in the train pipe must be reduced to a lower pressure than in the auxiliary reservoirs to set the brakes; but, if time be allowed to let the air equalize, all the air that has been forced back may be used to advantage. The device is used only in emergencies, and the rules provide for testing it at the beginning of every trip, in order to insure its use if needed. It is confidently depended upon by the men and is fitted to many locomotives that are used on long, heavy grades on the Santa Fe, the Southern Pacific and mountain roads in the far Northwest.

Mr. H. J. Small, Superintendent of Motive Power of the Southern Pacific, writes us that this device originated with one of the oldest engineers on that road. Some years ago, when the question of the advisability of equipping mountain locomotives with two air pumps was considered, the Sweeney device was introduced and it proved satisfactory, so that the idea of using a second air pump was abandoned. Mr. Small reports that he is now using this device not only on the mountain grades, but also on valley divisions. It is used as an emergency or auxiliary to the air pump. In case anything happens to the air pump, this device is ready for instant use. A number of cases of failure of air pumps have occurred on that road, not only on mountain grades, but on level divisions, and the trains were brought in safely, using the air brakes for which the supply of air was furnished solely by the Sweeney auxiliary.

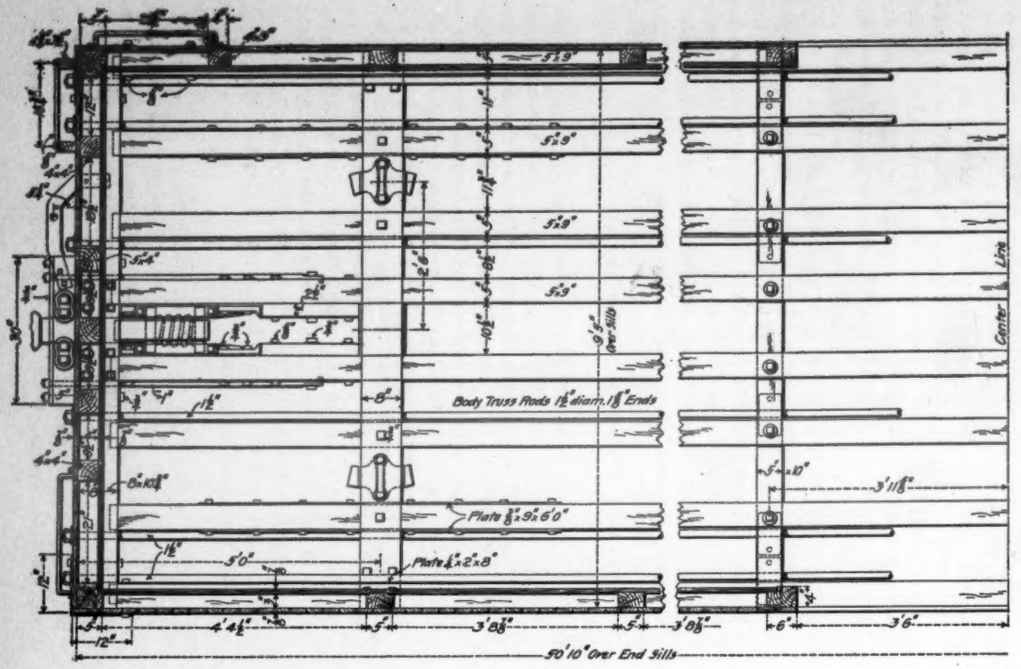
Mr. Small has very kindly sent us a report written by the Pacific Coast expert of the Westinghouse Air Brake Company, after witnessing the use of the Sweeney attachment on three different trains. In one of these cases one of the air valves of the locomotive air pump broke and a train of 560 tons was handled down a 3 per cent. grade, 25 miles long, with this device. There can be no doubt that with such grades, and even with shorter ones, and not as steep, this emergency apparatus will contribute to the safety of operation and also to the peace of mind of the engine and train crews.

BRAKE CONTROL OF DOUBLE-HEADED PASSENGER TRAINS.

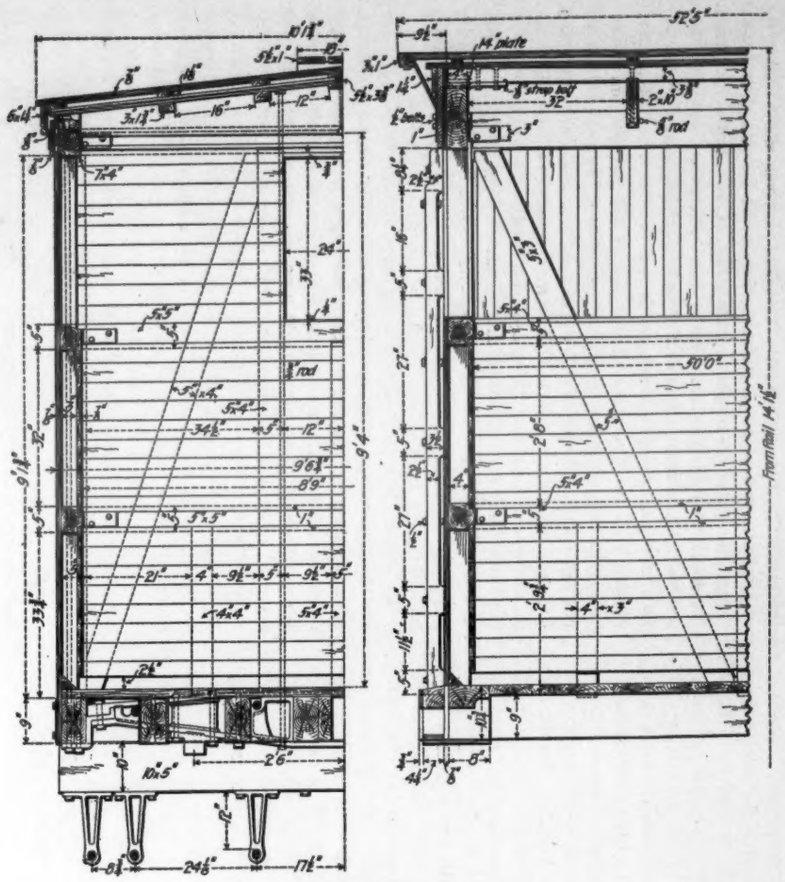
There is an opportunity for an accident whenever two locomotives are attached to the same train from the possibility of conflict of the enginemen in applying the brakes. Some protection against this contingency is necessary and specially so on mountain grades, where double-heading of passenger trains is the rule. In discussing the practice of cutting out the brakes on the leading engine before the Master Mechanics' Association, Mr. T. R. Browne and Mr. A. W. Gibbs, of the Pennsylvania, stated that on this road the engineer of the leading engine did the braking, the arrangement of the engineer's valve permitted the engineman of the rear engine only to apply the brakes. It was expressly arranged that he would not be able to release the brakes, for the reason that should the forward engineman discover the necessity of applying the brakes, while the engineman of the second engine had left his brake in a released position, the result would be a brake failure. Therefore the brakes are so arranged with double-headed passenger trains that the forward engineman has control not only of his own brakes and the train brakes, but also those of the rear engine; the rear man not having the power to release, Mr. Browne said:

This condition is somewhat altered on the mountain division, where double-headers are used for short distance only, and under these circumstances the engine next to the train controls and applies the brakes. It would appear to me that the head engine being in the lead should have the ability to apply the brakes, as the crew is in a position to see all the signals, as well as the second engine. It seems to me that to cut out the head engine entirely removes to a certain extent the possibility of throwing a part of the responsibility on that crew and throws it all upon the engine behind. From the standpoint of my experience and judgment in that matter I would naturally feel inclined to say that both crews should have it within their power to apply brakes on double-headers, which usually means a heavy train.

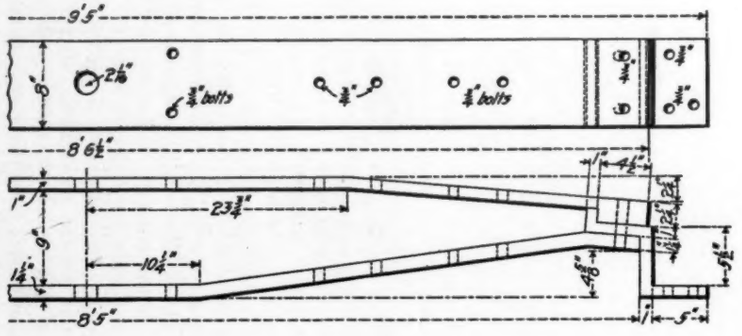
German engineers are pursuing improvement in steam engine efficiency by the use of superheated steam, and one direction which their progress is taking is the use of poppet valves to avoid the earlier difficulties of cutting and tearing valves, valve stems and seats. There is so much to be gained by superheating that it is well worth while experimenting, even at considerable expense, in order to overcome the difficulties.



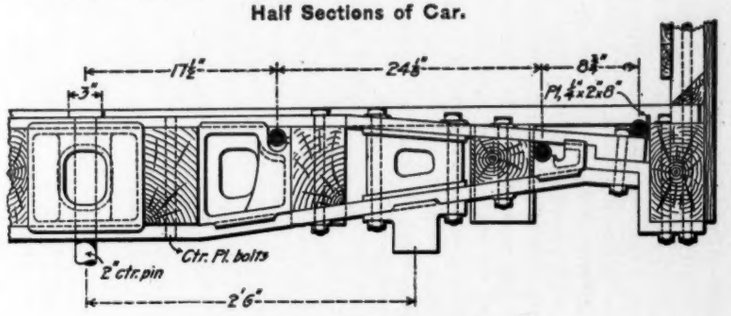
Plan View Showing Underframe.



Half Sections of Car.



Plan and Elevation of Body Bolster.



Half Section at Body Bolster.

50 Foot Furniture Cars, 60,000 Pounds Capacity.
Baltimore & Ohio Southwestern Ry.

50-FOOT FURNITURE CARS.

Baltimore & Ohio Southwestern.

Box cars 50 ft. 10 in. long over end sills and 9 ft. 5 in. wide over side sills, having a clear height inside of 9 ft. 4 in. under the car-lines, are always interesting, even if they do not present novelties in the framing. Furniture cars with these dimensions are to be built for the Baltimore & Ohio Southwestern, several drawings of which are presented here.

These cars have eight longitudinal sills, all of which are 5 by 9 inches in section, supported by six 1½-inch truss rods upset to 1⅝ inches at the ends. The needle beams are 5 by 10 inches in section and the queen posts are deep enough to bring the tops of the truss rods 22 inches below the lower faces of the sills. The truss rods are arranged as shown in the section of the under-frame at the body bolster. Two of them lie between the side sills and the first intermediate sill on each side, while the others lie at a distance of 17½ inches at each side of the center of the car. This distribution brings the greater part of the truss rod load near the ends of the body bolsters and may be criticised in the light of Mr. F. M. Whyte's paper before the Western Railway Club last year (See our January, 1899, issue, page 17), especially because of the great length of this car on account of which the duty imposed upon the truss rods is greater than is the case in shorter cars.

The end sills are 8 by 10¾ inches, the longitudinal sills are tenoned into them with double tenons 1½ by 1½ inches with a 3-inch space between them. The other principal timbers are of the following sections: Side plates, 4 by 7 inches; end plates, 4 by 14 inches at the center, tapered to 8¼ inches at the ends; carlines, 2 by 10 inches; purlines, 1¾ by 3 inches; ridge pole, 3⅜ by 5½ inches; door posts, 4 by 6 inches; end posts, 4 by 5 inches, and needle beams, 5 by 10 inches. The girths are double and 4 by 5 inches in section. The wheat line is 37 inches above the floor, and the corn line 40 inches, the capacity being 60,000 lbs.

The body bolster is of the plate type, the upper plate being 1 by 8 inches and the lower 1¼ by 8 inches, with a depth of 9 inches between the plates at the center. The connections between the ends of the plates are made over by 1 by 8-inch plate stirrups carrying the side sills. The center plates are malleable iron. By referring to the section at the body bolster and also the plan view it will be seen that the outside intermediate sills are reinforced by ⅜ by 9-inch plates, 6 ft. long, where they are cut out for the bolsters. As shown in the drawings, the draft gear is located between the center sills, the front draft lugs being supported against the end sills, while the rear lugs bear against blocks bolted to the center sills and extending back to the bolsters. The central bolts through these blocks take the ends of tension rods passing through the end sills and dead blocks. The trucks of these cars have bolsters made of three pieces of oak, two of which are 3¼ by 7½ inches, and the other 4 by 7 inches, with sandwich plates between them. This is a type of truck bolster of which the future will produce very few examples. These cars are a little longer than the 50-foot carriage cars built last year by the Chicago, Milwaukee & St. Paul and illustrated on page 8 of our issue of January, 1899.

VACUUM STEAM HEATING.

The relative advantages of pressure and vacuum in the pipes of steam heating systems have been investigated by Prof. J. H. Kinealy of St. Louis and reported by him in a paper before the American Society of Heating and Ventilating Engineers. The experiments were conducted in a small room on the street floor of a large office building in St. Louis, the outer walls being subjected to the temperature of the air out of doors. A radiator was used for heating and a connection was made to it for the air valves of the Paul system. Temperatures were taken at points about 5 feet from the floor.

The conclusions drawn from the tests are that it is more economical to heat with steam at a temperature less than 212 degrees than with steam at higher temperatures, and that the less the difference between the temperature of the steam in the radiator and the temperature of the air in the room measured at about five feet from the floor, the greater is the economy in the use of steam in heating, and this does not take into consideration the fact that steam for a vacuum system may be taken from an exhaust pipe without costing anything, but it is due to the low temperatures used. The author quoted experiments by Meidinger to show that radiators at high temperatures probably keep the air at the top of the room at a much higher temperature, for a temperature of 70 degrees at a point 5 feet above the floor, than a radiator at lower temperature would keep it and yet maintain the same temperature, 70 degrees, at the height of 5 feet. This meant a greater loss of heat with the high radiator temperatures, because they gave higher average temperatures in the room which resulted in a greater difference between the outside and inside temperatures, and this, in turn, caused greater loss of heat from the room and a corresponding consumption of fuel. The occupants of a room use the portion up to about 5 feet from the floor, and therefore that system was best which would maintain the lower 5 feet at the desired temperature and keep the lowest ceiling temperature. The author believed that this object was best attained by radiators having low temperatures.

The author then discussed the question of increasing the area of radiating surface to correspond with the reduction in the temperature of the radiator. The higher the radiator temperature the more steam would be condensed per square foot of surface per hour, but it did not necessarily follow that low temperatures required more surface because of the fact that in a vacuum system the air in the radiators is always withdrawn from the coils by the vacuum attachment, which made it possible to keep the radiators entirely full of steam. This gave the vacuum system the advantage because it insured against the short circuiting of the radiators on account of becoming "air bound." The radiator of the vacuum system employed their surfaces more efficiently, and the radiating surfaces of this system are therefore always larger than those having more or less air in them, which can never be completely removed in a system using pressures above the atmosphere. A more complete statement of Prof. Kinealy's work and his conclusions may be found in "The Engineering Record," July 29, 1899, page 202.

The length of boiler tubes is important, and it has been questioned whether increased heating surface may not be better obtained in s me other way. There is probably a best ratio between the length and diameter of tubes, but this does not seem to have been clearly established for locomotive practice. The experiments of Mr. Henry of the Paris-Lyons-Mediterranean Railway show that while increasing the length of tubes increases the boiler efficiency, an increase of 130 per cent. in length adds but about 30 per cent. to the amount of water evaporated per pound of coal. These results are summarized as follows:

Experiments on Heating Surface, Paris-Lyons-Mediterranean Ry.

Length of tubes in feet.....	9.84	13.1	16.4	19.7	23.0
Total heating surface, sq. ft....	972.2	1260.	1548.	1835.	2122.
Ratio heating to grate surface..	36.13	46.82	57.52	68.21	78.91
Draft of One Inch of Water.					
	lbs.	lbs.	lbs.	lbs.	lbs.
Combustion per square foot of grate	38.21	36.8	33.1	30.3	28.9
Water per pound of coal	7.87	9.01	9.65	9.94	10.20
	deg.	deg.	deg.	deg.	deg.
Temperature of smoke box	739.	608.	518.	460.	432.
	%	%	%	%	%
Loss of heat by chimney	17.4	13.7	11.4	10.2	9.77

TWO IMPROVEMENTS IN COMPOUND LOCOMOTIVES.

Richmond Locomotive and Machine Works.

Mr. C. J. Mellin, Chief Engineer of the Richmond Locomotive and Machine Works, has sent us drawings and information concerning two apparently important improvements in compound locomotives, both of which concern the losses of power, one in the disposition of the exhaust through the valve, and the other in a reduction of the resistance to the motion of the piston when drifting, and this effect is accompanied by the elimination of the draft action of the large cylinder when running with steam shut off. Mr. Mellin states that both improvements give good results as to increasing the speed, power and economy of compounds, and their effects are particularly noticeable at high speeds.

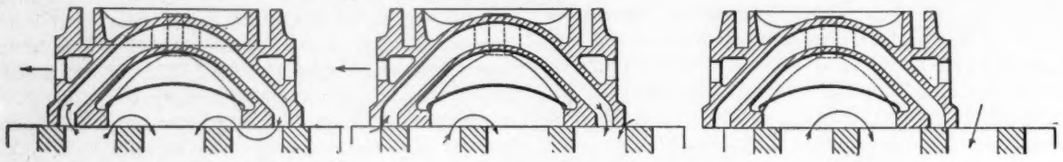


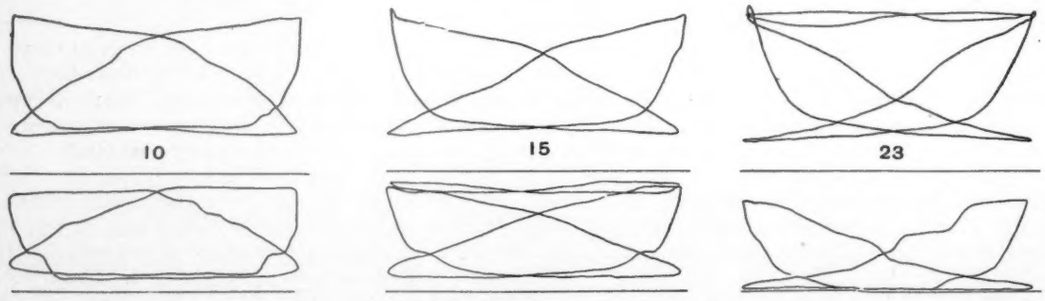
Fig. 1.—Mr. Mellin's Arrangement of the Allen Valve to Secure Double Port Effect.

Double Ported Valve Controlling Exhaust as Well as Admission.

The Allen valve has proved a success in locomotive practice and it appears to be constantly gaining friends because of its effective aid in improving the admission of steam. This port does not affect the action of the exhaust side of the valve and Mr. Mellin's new valve was designed to accomplish what the Allen valve does and also improve the disposition of the exhaust. This is an adaptation of the Allen port combined with a large amount of inside clearance of the main exhaust passage of the valve. The following description was prepared from information received from Mr. Mellin:

The time when the opening for the exhaust needs to be most efficient is at the beginning of the exhaust period. It is evident that when the exhaust opening becomes equal to the area of the exhaust nozzle a further increase in the area of the exhaust port opening will not assist the steam out of the cylinder. With the increase in piston speed a certain velocity is reached, after which the back pressure during the return stroke of the piston does not decrease, and for this reason an increase of the area of the exhaust opening after the beginning of the return stroke is of very little value. The pressure at the end of the stroke should therefore be decreased in order to secure a minimum back pressure throughout the stroke. The valve under consideration was designed to secure a more rapid exhaust opening, and is termed "double ported," to distinguish it from the Allen valve. The valve port is used as an exhaust as well as an admission passage. The use of this device on compound locomotives gives low back pressure at high speeds without necessitating the use of large valves. The advantage of small valves and short valve travel on freight engines is fully appreciated. While this plan is working very satisfactorily on high-speed locomotives on the St. Louis Southwestern, we have no record of the speed except the report that it is satisfactory.

The drawing, Fig. 1, illustrating various positions of the valve, shows that the auxiliary port acts as an exhaust port only during the first portion of the exhaust period. When the main exhaust passage becomes sufficiently open the supplemental passage closes and it afterward becomes temporarily an admission passage. The valve is shown in three positions, the arrows indicating the directions of the steam currents. Indicator cards and the valve diagram drawn above the ideal cards, are shown in Figs. 2 and 3. Fig. 3 illustrates the difference between the plain valve, the Allen ported valve and Mr. Mellin's device. These valves are shown when cutting off at half stroke. The full line, No. 1, represents the action of the double ported valve, the dotted line, No. 2, is that of the plain valve, and the broken line, No. 3, represents the Allen valve, all of the conditions being the same except as to the supplemental ports, and the diagram is drawn on the assumption that the velocity of the steam is the same at corresponding points on the three cards. The admission and expansion lines of No. 1 and No. 3 coincide, but the exhaust and back pressure lines of No. 1 show a decided advantage. From the release point, C, to E, the effect of the auxiliary exhaust passage is plain, and yet the area of the exhaust nozzle is still considerably larger than that of the port opening. The re-



Card No. 10.		Card No. 15.		Card No. 23.	
Speed, miles per hour	28	Speed, miles per hour	35	Speed, miles per hour	41
Boiler pressure	174 lbs.	Boiler pressure	180 lbs.	Boiler pressure	180 lbs.
Initial pressure	171 lbs.	Initial pressure	175 lbs.	Initial pressure	165 lbs.
M. E. P., H. P	81.5 lbs.	M. E. P., H. P	61.5 lbs.	M. E. P., H P	34.1 lbs.
" L. P	28 6 lbs.	" L. P	21.5 lbs.	" L. P	14 8 lbs.
Distribution of work, H. P.	53.2 per cent.	Distribution of work, H. P.	53.2 per cent.	Distribution of work, H. P	47.9 per cent.
" " L. P.	46.8 per cent.	" " L. P.	46.8 per cent.	" " L. P	52.1 per cent.

		H P.	L. P.
Diameter of H. P. cylinder	20¼ in.	Inside clearance, front	3/16 in.
" L. P. "	32½ in.	" " back	3/16 in.
Length of stroke	24 in.	Valve travel	5.78 in.
Ratio of cylinder areas	2.51	Lead	1/4 in.
Indicator spring, H. P	100 lbs.	Outside lap	1 1/16 in.
" " L. P	40 lbs.	Width of auxiliary port	7/8 in.

Fig. 2.—Low Pressure Cylinder with Double Ported Valve.

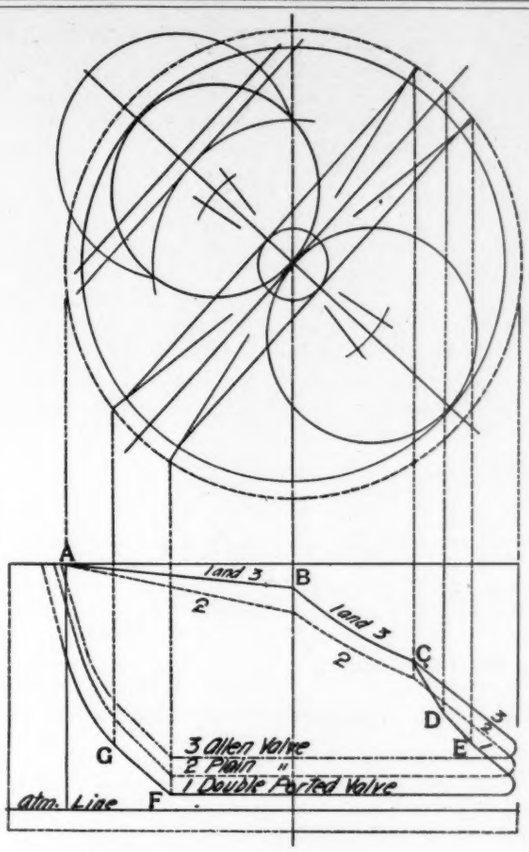
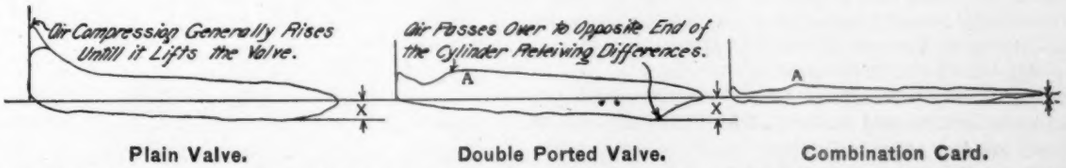


Fig. 3.—Comparisons of Valves.

sulting final pressure causes a lower back pressure during the entire return stroke.

The admission and expansion lines of the plain valve fall below those of the other valves, and the release pressure is correspondingly lower. As the area of the exhaust opening is the same for the plain and the Allen valves, the exhaust line of the plain valve is below the Allen, through the return stroke and the exhaust line of the Mellin valve crosses that of the plain valve at a point near the end of the stroke. Another advantage of the new valve is shown in Fig. 4, illustrating diagrams, the conditions which occur when drifting. The confined air is compressed to the pressure shown at A, when the auxiliary port opens to relieve the pressure by allowing the air to pass over to the suction side of the piston before the piston reaches the end of its stroke, and the final compression is much lower than it would be with a plain valve. This engraving, Fig. 4, brings out the combined effect of the double ported valve and the "over-pass" valve in reducing the air resistance of the piston when drifting.


Air Compressing Generally Rises Until it Lifts the Valve.
Air Passes Over to Opposite End of the Cylinder Relieving Differences.
A
X
A
X

Plain Valve. Double Ported Valve. Combination Card.

Fig. 4.—Illustrations Showing Effects of Double Ported Valves, Plain Valves and Combination of Double Ported Valve and By Pass Valve.

In the valve diagram, Fig. 3, the dotted outer circle represents the crank path, the next one gives the travel of the valve, the circle at the left is the steam, and that at the right the exhaust, the circle at the center of the figure being the negative exhaust lap circle. The inner crescent formed by the steam lap as a radius is the ordinary steam opening, and the outer crescent partly enclosing the former, represents the auxiliary port opening for steam. The distance between the straight parallel lines crossing the steam circle is the lead. The opening of the auxiliary port as an exhaust port and the negative lap are represented by the curves intersecting each other at the center of the figure. They are measured across the center of the figure on the reverse curves until the inclined center line is reached, after which it follows the small circle and the exhaust circle from the point of intersection of the latter circle. At the closing of the valve the opposite reverse curves go into effect in the same manner. The other points are connected with the diagrams below the valve diagram by projecting downward.

"By-Pass" Valves for Low-Pressure Cylinders of Compound Locomotives.

The pumping action of the low-pressure cylinder is rendered ineffective by a by-pass or "over-pass," which is an open passage from one end of the cylinder to the other. This passage is in a projection cast upon the outside of the cylinder just below the steam chest, which has become a feature of Richmond compounds. This valve was designed by Mr. Mellin. It is shown in relation to the steam passages and in both the open and closed position. The cylinders at the ends of the valve communicate with the valve chamber, and when the throttle is closed the vacuum in the chamber causes the valves, A A, Fig. 5, to separate and open the passage between the ends of the cylinder. Upon the opening of the throttle the steam pressure from the valve chamber comes upon the valves, A A, Fig. 6, forcing them toward each other and closing communication through the by-pass. A small vent at the center of the by-pass opens to the atmosphere. It is found advisable to admit some external air in order to prevent the cylinder from becoming too highly heated through friction of the air, and also to insure against drawing smokebox gases into the cylinder. The double piston shown in the engravings is used to cushion the movements of the by-pass valves. These valves are made as large as 5 inches in diameter, and their movements are very rapid.

The two-cylinder compound has not been considered as a favorable type for use where much drifting is to be done because of the pumping action of the large cylinder, which has an important fanning effect on the fire when the engine is running with the throttle closed. There has also been some trouble with the lubrication of the large cylinders, and in spite of large relief valves which have been applied to steam chests the trouble has not yet been satisfactorily overcome by taking in exterior air in this way. Admitting fresh air also has the disadvantage of cooling off the cylinder, which causes a large amount of condensation when steam is again admitted. Mr. Mellin's device avoids this trouble and affords relief that could not be obtained without using excessively large relief valves. The cards taken from engines with and without these valves show the reason for the criticism often heard, to the effect that the gain secured by compounds running up hill and on level stretches of roads, where they must do a great deal of drifting, is lost again by the fanning of the fire by the action of the cylinders.

The drifting cards shown in Fig. 7 illustrate the effect of the over-pass valve in reducing the resistance to the motion of the piston. Diagrams A and B show cards from a Chesapeake & Ohio locomotive with 20 and 32-inch cylinders, before and after the over-pass device was applied. In card A the stroke was 24 inches. This was increased 2 inches when the change was made. Both cards were taken with the throt-

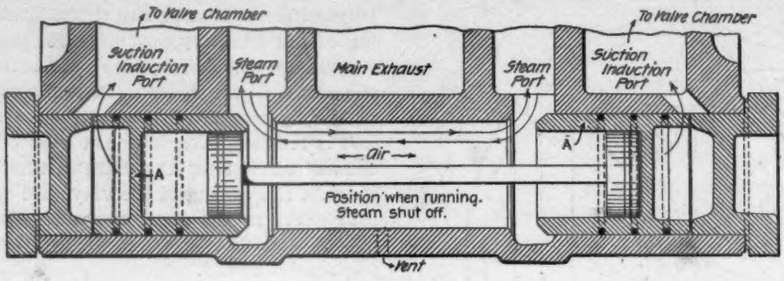


Fig. 5.—Position of By Pass Valve when Running with Steam Shut Off.

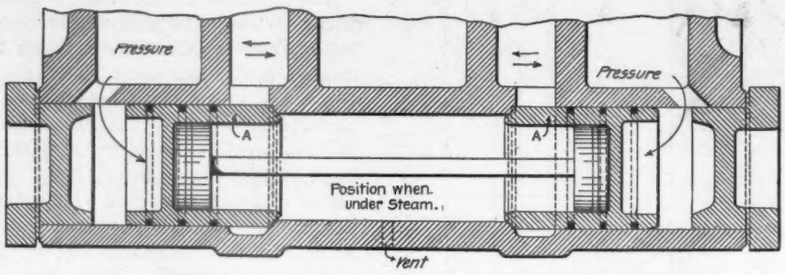
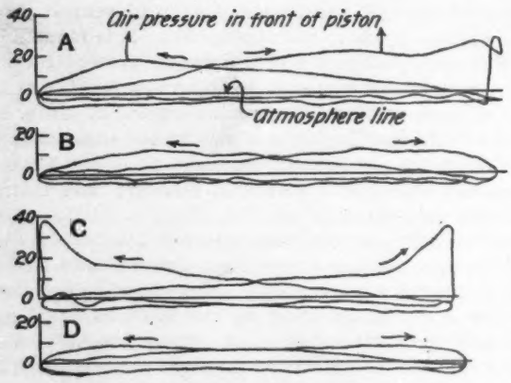


Fig. 6.—Position of By Pass Valve with Throttle Open.



Diagrams A and C without over-pass valve.
" B " D with " " "

Fig. 7.—Indicator Cards from Low Pressure Cylinder of Richmond Compound when Drifting.

tle closed and the reverse lever in the first notch. The piston speed for both cards was 986 feet per minute. It is stated that the cards from the high-pressure cylinder at this speed were approximately straight lines. Some irregularities in the pressure are shown in diagram A, which is attributed to yielding or springing in the indicator motion.

Cards C and D were taken from two locomotives with the same sized cylinders, 20 and 32 by 24-inch diameter, and at approximately 920 feet per minute piston speed. Card D shows the advantage of the over-pass. As previously stated, Fig. 4 shows the combined action of the double ported valve and the "over-pass."

The twin screw steamer "Chester W. Chapin" for the New York & New Haven Line, recently launched at the yards of the Maryland Steel Company, at Sparrow's Point, Md., is to cost $500,000 and will have a speed of 21½ statute miles per hour. She is 324 feet long on deck, 310 feet on the water line, 64 feet wide over the guards and 17 feet 2½ inches deep. The engines are surface condensing, triple expansion, with cylinders 24, 38 and 60 inches diameter by 30 inches stroke. They are to develop 4,200 indicated horse power. The boilers, six in number, are of the Scotch type, 13 feet in diameter and 11 feet 6 inches long, working at a pressure of 160 pounds. The vessel will be heated by steam and lighted by electricity and is expected to be ready for service early in September.

CONVENIENT TABLE FOR TUBE HEATING SURFACES.

It is customary to compute the heating surface of tubes by considering the outside diameter and for convenience in getting at the figure for total tube heating surface quickly when the length, number and diameter of the tubes are known, Mr. Francis J. Cole arranged the accompanying table, for which

HEATING SURFACE OF FLUES IN SQUARE FEET.

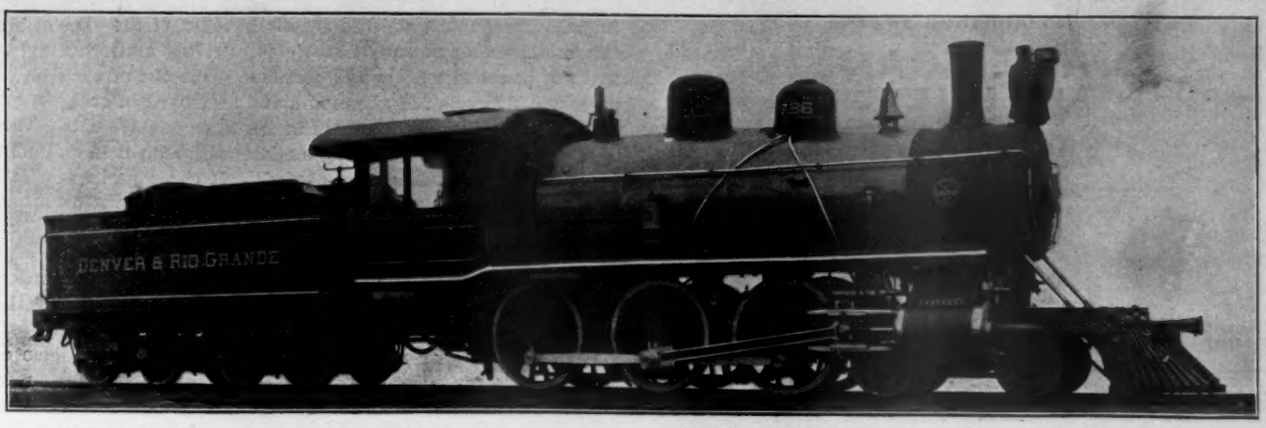
OUTSIDE DIAMETER.

Outside Diameter of Flues.	Circumferences in Inches.	Feet.								
		7	8	9	10	11	12	13	14	15
1½	4.7124	2.749	3.139	3.531	3.924	4.316	4.709	5.111	5.494	5.886
1¾	5.4978	3.207	3.665	4.123	4.582	5 040	5.496	5 956	6.414	6.872
2	6.2832	3 665	4 189	4 712	5.236	5.760	6.283	6.807	7.330	7 854
2¼	7.0686	4.120	4.711	5 298	5.887	6.476	7.064	7 653	8.242	8 830
2½	7.8540	4.581	5.236	5.890	6 545	7.199	7.854	8.508	9.163	9.817

Outside Diameter of Flues.	Circumferences in Inches.	Inches.											
		1	2	3	4	5	6	7	8	9	10	11	12
1½	4.7124	.033	.065	.097	.131	.164	.196	.229	260	.294	327	.360	.392
1¾	5.4978	.038	076	.114	.152	.191	.229	.267	305	.342	382	.418	458
2	6.2832	.044	.087	.131	.174	218	.262	.305	349	392	436	479	528
2¼	7.0686	.049	.093	.147	.196	.245	.294	.343	393	.442	491	.539	.589
2½	7.8540	.054	.119	163	218	.272	.327	381	.436	.490	540	.599	.654

Outside Diameter of Flues.	Circumferences in Inches.	Fractions of an Inch.														
		0	1/16	2/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
1½	4.7124	.002	004	.006	.008	010	.012	014	.016	.018	.020	.022	.024	.026	.028	.031
1¾	5.4978	.002	.005	.007	.009	.012	.014	.017	.019	.021	.024	026	.028	.031	.033	.036
2	6.2832	.003	005	.008	.011	.013	016	.019	.022	.024	.027	030	.033	.035	.038	041
2¼	7.0686	.003	.006	.009	.012	015	.018	.021	.024	.028	.031	.034	.037	.040	.043	046
2½	7.8540	.003	.007	.010	.014	017	.020	.024	.027	.031	034	037	.041	.044	.048	051

we are indebted to the "Boiler Maker." In this table the number of square feet of heating surface in tubes from 7 to 15 feet long and from 1½ to 2½ inches in diameter are given, also the same information for each inch up to a foot in length, and for the fraction of an inch. In using the table, add together the heating surface for the feet, inches and fraction of an inch for one tube and multiply by the number of tubes.



Ten-Wheel Passenger Locomotive—D. & R. G. Ry.—With Piston Valves.

Built by THE BROOKS LOCOMOTIVE WORKS.

TEN-WHEEL PASSENGER LOCOMOTIVES.

Denver & Rio Grande.

Brooks Locomotive Works, Builders.

The accompanying engraving is from a photograph of one of 10 heavy 10-wheel passenger locomotives recently built by the Brooks Locomotive Works for the Denver & Rio Grande. These engines have 21 by 26 in. cylinders, with 10-in. piston valves, and the boilers will carry a pressure of 210 pounds per square inch, which we believe is the highest pressure carried on single expansion engines in American practice. The weight in working order is 160,000 pounds, 124,000 pounds being on the driving wheels. The boiler is of the extended wagon top, radial stayed type, with a total heating surface of 2,422 square feet. The grate area is 33.5 square feet, the firebox being 109 by 41 inches. The engines have Westinghouse air pumps and tender brakes and New York driver brakes. The following table gives the chief dimensions:

Fuel	Bituminous coal
Weight on drivers	124,000 lbs.
Weight on truck wheels	36,000 lbs.
Weight, total	160,000 lbs.
Weight tender loaded	112,000 lbs.
Wheel base, total, of engine	23 ft. 7 in.
Wheel base, driving	13 ft. 0 in.
Wheel base, total, engine and tender	53 ft. 10¾ in.
Length over all, engine	39 ft. 11⅞ in.
Length over all, total, engine and tender	65 ft. 10⅝ in.
Height, center of boiler above rails	8 ft. 6 in.
Height of stack	14 ft. 11½ in.
Heating surface, firebox	165 sq. ft.
Heating surface, tubes	2,257 sq. ft.
Heating surface, total	2,422 sq. ft.
Grate area	33.5 sq. ft.
Drivers, diameter	63 in.
Drivers, material of centers	Cast steel
Truck wheels, diameter	33 in.
Journals, driving axle, size	9 x 12 in.
Journals, truck axle, size	5½ x 12 in.
Main crank pin, size	6¼ x 6½ in.
Cylinders, diameter	21 in.
Piston stroke	26 in.
Piston rod, diameter	3½ in.
Kind of piston rod packing	Metallic
Main rod, length center to center	9 ft. 7 in.
Steam ports, length	21 in.
Steam ports, width	2 in.
Exhaust ports, least area	50 sq. in.
Bridge, width	3¼ in.
Valves, kind of	Piston
Valves, greatest travel	6¼ in.
Valves, steam lap (inside)	1⅛ in.
Valves, exhaust lap or clearance (outside)	0 in.
Valves, lead in full gear, negative	1/16 in.
Boiler, type of	Extended wagon top
Boiler, working steam pressure	210 lbs.
Boiler, material in barrel	Steel
Boiler, thickness of material in barrel	¾ in.
Boiler, diameter of barrel	68 in.
Seams, kind of horizontal	Sextuple riveted
Seams, kind of circumferential	Double riveted
Thickness of tube sheets	front, ⅝ in.; back, ½ in.
Thickness of crown sheet	⅜ in.
Crown sheet, stayed with	Radial stays
Dome, diameter	32 in.
Firebox, length	10 ft. 1 in.
Firebox, width	3 ft. 5 in.
Firebox, depth, front	79 in.
Firebox, depth, back	68 in.
Firebox, material	Steel
Firebox, thickness of sheets	⅜ in.
Firebox, brick arch	None
Firebox, water space, width	front 4½ in., sides 4 in., back 4 in.
Grate, kind of	Cast-iron rocking
Tubes, number of	326
Tubes, material	Charcoal iron
Tubes, outside diameter	2 in.
Tubes, length over sheets	13 ft. 3 13/16 in.
Smokebox, diameter	69 in.
Smokebox, length	61 in.
Exhaust nozzle	Single
Exhaust nozzle, diameter	5¼ in.
Exhaust nozzle, distance of tip below center of boiler	6½ in.
Netting	Wire
Netting, size of mesh	2½ x 2½ in.
Stack	Taper
Stack, least diameter	14½ in.
Stack, greatest diameter	17½ in.
Stack, height above smokebox	3 ft. 7 in.

Tender.

Type	Eight wheel, steel frame
Tank capacity for water	5,500 gals.
Coal capacity	8 tons
Kind of material in tank	Steel
Thickness of tank sheets	¼ and 5/16 in.
Type of under frame	Steel channel
Diameter of truck wheels	38 in.
Diameter and length of axle journals	5 x 9 in.
Distance between centers of journals	5 ft. 0 in.
Diameter of wheel fit on axle	6 in.
Diameter of center of axle	5¼ in.
Length of tender frame over bumpers	23 ft. 5½ in.
Length of tank	21 ft. 8 in.
Width of tank	9 ft. 0 in.
Height of tank, not including collar	4 ft 9⅝ in.

THE PRESENT DEMAND FOR STEEL.

Owing to the great difficulty in obtaining steel for current needs, about 1,500 men are reported to have been laid off at Cramp's shipyard, and the result is likely to be a delay in the completion of work now in hand. In a published interview Mr. Edwin S. Cramp recently compared the consumption of steel in the building of cars and ships, and stated that the Pressed Steel Car Company uses more material at the present rate of consumption than is required by all of the shipyards in the country combined. About 3 per cent. of the country's steel output goes into ships, and the present difficulty is to secure that much. The Pressed Steel Car Company has a contract with Carnegie requiring 1,000 tons a day, and we are informed that only about 60 per cent. of that amount is now supplied.

When 18-inch I-beams, weighing 2,000 pounds each, are in such demand as to warrant their shipment by express, the condition of the steel business may be considered phenomenal. A Pittsburgh dispatch describes the situation in regard to the supply of steel shapes in that city by stating that this was actually required on a recent order, and it is safe to say that such a state of affairs in the steel business never was known before. It is not supposed that many beams of this size and weight were delivered in this way, but even one is enough to indicate the necessity of the case. The great difficulty at present is to get steel material, and particularly rolled shapes and steel castings. Immediate shipments on new orders are now practically impossible, though we have heard of cases in which offers of bonus have been made. The demand for structural steel has been increased by the fear of higher prices in the fall.

(Established 1832)

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE,

J. S. BONSALL, Business Manager.

MORSE BUILDING..... .....NEW YORK

G. M. BASFORD, Editor.

SEPTEMBER, 1899.

Subscription.—$2.00 *a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*

Remit by Express Money Order, Draft or Post-Office Order.

Subscriptions for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn Street, Chicago, Ill.

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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COUPLER SPECIFICATIONS AND GUARANTEES.

The recent adoption of standard specifications for couplers which are exacting enough to require good material and correct design is a step which was greatly needed and which, considering the fact that an able committee is to examine couplers on this basis with the aid of adequate apparatus, is likely to reduce the number of inferior and dangerous couplers. If the present specifications (see "American Engineer, July, 1899, page 238) are not exactly what are wanted, they may be made so as a result of experience, and it may be accepted that all that is to be accomplished by specifications may be accomplished as a result of the recent action of the M. C. B. Association. Specifications, however, will not bring about all of the results that are desired. They outline what is wanted and they furnish a measure by which to examine new and old couplers, but they alone will not encourage manufactureres to produce the best work of which they are capable.

The testing of wheels, axles and couplers is becoming a serious question because of the difficulties introduced by the necessity for destructive tests in order to show the quality of the material. Boiler steel may be safely accepted upon the successful tests of coupons sheared from the edges of the sheets, but this method does not apply so well to driving and other axles, and not at all to wheels and couplers. One out of each lot of perhaps 100 is selected at random and destroyed in order to examine the quality of the others in the same consignment. This is obviously an unsatisfactory method, although it is undoubtedly the best that has been devised. It gives perhaps a fair idea of the quality of the entire order and perhaps it does not. Furthermore, unless running numbers are stamped on the individual pieces of a shipment, there is no guarantee that a condemned lot will not appear for test on a subsequent order, whereupon if the piece tested meets the specifications the whole lot would pass the second time.

It is clear that there is nothing that will take the place of inducements for manufacturers to take every precaution to turn out the best of work and service guarantees, coupled with specifications and a disposition to pay fair prices, will bring better results than are to be had in any other way. The tendency to run after low prices lies at the bottom of the coupler troubles to-day, and until the danger of this idea is realized, not even the best of specifications will avail.

The best manufacturers watch their product very closely, keeping their chemists busy with daily examinations of the metal used, and the most reliable concerns go as far as to run test bars on couplers and to test every heat of metal of which couplers are made, in order to permit of using the tensile machine as well as the chemical laboratory to keep the material up to the highest standard.

People who take this trouble and who are also willing to guarantee their couplers against wear and breakage are among the best friends that the railroads have, and for the best of business reasons they should be encouraged. Such concerns have no dread of fair specifications, but we would emphasize the fact that there are many elements which go to make good couplers which specifications will not reach. These depend on the integrity of the manufacturer, and they are very important.

DOES WINTER WEATHER AFFECT LOCOMOTIVE COAL CONSUMPTION?

"Does the temperature of the atmosphere have any appreciable effect on the amount of coal consumed by locomotives? If it does, what is the approximate per cent. of increase in coal required in the same service in zero weather over the amount necessary when the thermometer stands at 70 degrees above zero?"

This question, propounded as a subject for topical discussion before the St. Louis Railway Club, is an important one, which may or may not bring out definite figures. It will be surprising if any conclusive information is presented in the expected discussion because of the great difficulty in securing anything definite in regard to the losses of heat in locomotives while running on the road.

That there are great losses of power of locomotives in cold weather is proven by the material reduction of train loads. Most recent methods for the rating of locomotives are provided with special reductions to be used in making up trains in cold weather, and these vary from 10 to 20 per cent. The recent tests of boiler coverings made on the Chicago & Northwestern directed attention to the desirability of extending the ordinary coverings of boilers to the exposed surfaces of the fireboxes, and that road now covers its fireboxes with lagging so arranged as to protect the surfaces from a large part of the radiation and at the same time the stay bolts are not rendered inaccessible for inspection and repairs.

The firebox surfaces undoubtedly need to be covered, but the heat insulation should not end there, because there is probably a much more serious source of loss than that from the water legs of the boiler when the locomotive is rushing through an atmosphere of low temperature.

It was noticed that the application of heat insulating lagging to cylinders on the Chicago & Northwestern, several

years ago, made an appreciable effect upon the power of locomotives in their winter ratings, and this practice points at once to the very important losses of heat through the cylinder walls. We have taken the position that not only should the cylinders be protected, but also the saddle castings through which the steam must pass on its way to the cylinders, and which are in the most exposed part of the engine. It is well known that water coming into the cylinders during the admission of steam not only affects the economy of the engine adversely, but it also reduces the power of the engine to a considerable extent, and one way to reduce this condensation is to guard as far as possible against the loss of heat of the steam on its way through the saddle castings. It would be easy to improve in this direction, and it is strange that it has not already become common practice.

It is to be hoped that this question will receive attention in the discussion expected from the introduction of this topic. It is important to know the proportion of loss of power in winter, but it seems to be more important to discuss possible ways for reducing the losses, which are known to be large, especially when it must be admitted that the proportion is almost impossible to ascertain.

PENNSYLVANIA RAILROAD PENSION SYSTEM.

The Pennsylvania Railroad has decided to establish a system of pensions and will provide a superanuation fund for the benefit of employees. This example is worthy of being followed, and we hope that one result of the present excellent condition of business will be an increased attention to the duties of the companies to their men. The manner of American railroad development was such as to crowd such questions as this into the background, for the reason that many of the roads have had a continuous struggle to keep out of the hands of the courts, but it is beginning to be recognized that railroad service may be greatly improved by giving the men reasons for desiring to retain their situations. The schemes of urging employees to purchase their homes and to secure shares of stock of the road tend in this direction. Men with responsibilities must be steadier and more valuable to their employers and also more successful from their own point of view than those who feel little hesitation in changing about. There can hardly be a better check against this floating tendency than the pension or superanuation fund, which insures a faithful and competent employee a living after he is too old to work. The prospect which such a plan holds out to a man must necessarily prove a strong influence, which will in the majority of cases result in a net gain to the company, even when viewed only on its commercial side. The pension system may be expected to insure a steady, contented lot of men, who respect their "company," but it need not deaden ambition or retard progress—if the requirements are high. This idea and the system of discipline without suspension have many points in common, and the latter may prove to be an entering wedge for the former.

Many roads have now begun to find their men growing old and the problem is: What to with them. They cannot earn enough to warrant continued employment, and yet they have served their employers faithfully for perhaps thirty and more years. During all these years they should have been saving against the future, but whether they have done so or not, there is a clear obligation on the part of the employer to provide for them in a way which shall not resemble charity, but shall partake of the idea of reward for long and faithful service in work which is usually both responsible and exacting.

The Pennsylvania is providing for about 75,000 men and will require about $325,000 as an annual outlay. Employees between the ages of 65 and 70 years who have served the company 30 years will be allowed to retire from active service, or they may be retired by the management of the fund. The age when retirement is compulsory is 70 years, and the pension paid will be proportional to the average wages paid each employee during a certain number of years, which does not necessarily cover the entire time of service, and an additional allowance will be paid out of the interest on the surplus of the Relief Fund, the amount being based upon the payments which they have made while members of that organization.

It is understood that the pension plan will go into effect at the beginning of next year, the number of pensioners being 775, 672 of these will be over 70 years of age at that time. There are now 3,000 men in the service who are over 60 years old; there are 50 who are over 80 years, and 99 men employed on the Delaware & Raritan Canal have been in the service over 45 years; one has worked for the company 63 years and another 61 years. An accompaniment to the pension plan is a new rule to the effect that no one over 35 years will be taken as a permanent employee, and those taken will be required to pass a physical examination. The pension fund is in the hands of a committee of officers of the company, and its privileges will be offered to employees without regard to the membership in the Relief Fund.

This scheme has been very carefully considered, with a view of the best interests of the company, as well as those of the men. It is to be hoped that the future will find many railroads in position to follow this example. They will undoubtedly take the question into consideration when it is possible, and there seems to be no doubt of the appreciation of the employees, One result which may be expected is a diminution of anxiety in regard to labor difficulties.

A smoke consuming or smoke prevention system has been developed in Berlin, Germany, very satisfactory results being reported by Consul General Mason. The system employs ordinary grate bars alternated with hollow ones perforated to distribute air to the fire from a fan blower. The air is heated in a manifold before passing into the hollow bars and it issues into the fire in the form of highly heated jets. It has been demonstrated that low grades of fuel may be burned by this form of grate without smoke. It is patented in the United States by Paul Cornelius of Berlin. Patent No. 613,-359.

The successful replacement of the Passaic River drawbridge of the Pennsylvania Railroad, near the Market Street Station, Newark, N. J., in a remarkably short time is worthy of record. The old bridge had been in use 30 years and was too light for present day requirements. The new span, 213 feet long, was built by the Edgemoor Iron Company and erected near the old span. The old draw span was raised by jacks and drawn out of the way and replaced by the new one in 18½ minutes, although the bridge was out of service for a longer time. The work was entirely successful, credit for the plans and execution being due to Messrs. G. B. Beale and L. H. Barker, engineers of the Pennsylvania. The work was done Sunday, July 23. The new span weighs about 600 tons and the old one 400 tons. As they were coupled together when moved, the load was about 1,000 tons.

The remarkable fast time on the Vandalia, made by one of the new Schenectady 8-wheel passenger locomotives, was briefly noted last month. We have just received particulars of several other runs which, in view of the weight of the trains, are specially noteworthy. Mr. H. I. Miller, Superintendent of the Vandalia, writes that engine No. 16 hauled train No. 20, July 14th, from Clayton to Transfer Station, 18 miles, in 18 minutes. The train consisted of two postal cars, one combined coach and baggage car, eight coaches, one dining car and two sleepers, 14 cars, weighing 548.2 tons and carrying 460 passengers. The same locomotive hauled train No. 20 the next day between these stations in 16 minutes, the train of 13 cars consisting of two postal cars, one combined coach and baggage car, seven coaches, one dining car and two sleepers, weighing 500.8 tons. These weights do not include the locomotive, which weighs 139,000 pounds. The train on the 20th ran from Coatesville to Transfer Station, 26 miles in 26 minutes.

PERSONALS.

Mr. Frank Cain, Master Mechanic of the Texarkana & Fort Smith, has resigned.

Mr. N. W. Best has been appointed Superintendent of Motive Power and Machinery of the Los Angeles Terminal Railway.

Mr. W. Richmond has been appointed Master Mechanic of the Lake Shore & Ishpeming, with headquarters at Marquette, Mich.

Mr. R. E. McCuen, General Foreman Lexington & Eastern, has been appointed Master Mechanic, with office at Lexington, Ky.

John Torrance, Superintendent of Motive Power and Rolling Stock of the Evansville & Terre Haute, died at Evansville, Ind., on August 2.

Mr. Isaac Seddon has been appointed Purchasing Agent of the Chicago, St. Paul, Minneapolis & Omaha, to succeed Mr. W. H. S. Wright.

Mr. J. E. Capps, Foreman Car Repairs Georgia Southern & Florida, has been given the title of Master Car Builder, with headquarters at Macon, Ga.

Mr. F. W. Williams has been appointed Division Master Mechanic of the Delaware, Lackawanna & Western at Syracuse, to succeed Mr. L. Kistler, resigned.

Mr. Joseph Buker, Superintendent of the Consolidated Cattle Car Company, has been appointed Assistant Superintendent of Machinery of the Illinois Central.

Mr. L. B. Rhodes, Foreman of the machine shops of the Georgia Southern & Florida, has been appointed Master Mechanic, with headquarters at Macon, Ga.

Mr. H. A. Webster has been appointed Master Mechanic of the Manhattan Railway, in charge of the mechanical and car repair departments, which have been consolidated.

Mr. P. G. Cauton has been appointed Purchasing Agent for the Yucatan Southeastern Railroad, a new road to be built in Yucatan. His office is at 29 Broadway, New York.

Mr. Philip Wallis, Master Mechanic of the Lehigh Valley at Easton, has been appointed to succeed Mr. Samuel F. Prince as Superintendent of Motive Power of the Long Island Railroad.

Mr. A. C. Loucks, formerly Traveling Engineer, has been appointed Acting Master Mechanic of the Missouri, Kansas & Texas, at Denison, Tex., to succeed Mr. T. C. McElvaney, resigned.

Mr. Joseph W. Taylor, Secretary of the American Railway Master Mechanics' Association and the Master Car Builders' Association, has changed his address to Room 667 The Rookery Building, Chicago.

Mr. J. A. Edson has been appointed General Manager of the Kansas City, Pittsburgh & Gulf, the Texarkana & Fort Smith and the Kansas City, Shreveport & Gulf Railways, to succeed the late Robert Gillham.

Mr. Howard James has been appointed Purchasing Agent of the Great Northern Railway to succeed Mr. S. F. Forbes, resigned. Mr. James was formerly Purchasing Agent of the Northern Steamship Co.

Mr. W. E. Chester, general foreman of the Central of Georgia, at Columbus, Ga., has been promoted to the position of Master Mechanic, to succeed Mr. J. L. Whitsitt, who has been transferred to Savannah.

Mr. Amos Turner has been appointed Division Master Mechanic of the Lehigh Valley at South Easton, Pa., to succeed Mr. Phillip Wallis, resigned. Mr. Turner was formerly General Foreman of the shops at Easton.

Mr. C. Graham, Jr., has been appointed Division Master Mechanic of the Delaware, Lackawanna & Western, in charge of the Buffalo and Cayuga Divisions, with headquarters at East Buffalo, to succeed Mr. F. B. Griffith, resigned.

Mr. Robert O'Brien has been appointed Master Mechanic of the Atlantic Coast Line, with headquarters at Richmond, Va., to succeed his father, Mr. John O'Brien, who has been appointed General Fuel Clerk at Manchester, Va.

J. G. Tomlinson, Superintendent of Motive Power of the New Orleans & Northeastern, was run over by a locomotive and killed at Meridian, Miss., July 25. He was connected with the Queen & Crescent system for more than 15 years.

Mr. T. W. Demarest, Roundhouse Foreman of the Pennsylvania Lines at Indianapolis, Ind., has been appointed Master Mechanic of the Logansport division, with headquarters at Logansport, Ind., to succeed the late W. C. Pennock.

Mr. H. C. McCarthy, for a number of years connected with the Pennsylvania as Chief Inspector of the Northern Central at Williamsport, Pa., has resigned and accepted an appointment as Mechanical Expert of the Galena Oil Company.

Mr. W. G. Noxin, Chief Clerk of the Purchasing Department of the Missouri Pacific, has been appointed Purchasing Agent, with office at Saint Louis, to succeed Abram Gould, deceased. Mr. George Snodgrass has been appointed Assistant Purchasing Agent.

Mr. James K. Brassill has resigned as Assistant Master Mechanic of the Chicago, St. Paul, Minneapolis & Omaha, at Sioux City, to accept the position of Master Mechanic of the California Northwestern at San Francisco. He will have entire charge of the motive power department, including floating equipment.

Mr. E. B. Thompson has returned to the Chicago & Northwestern Ry. to succeed Mr. F. M. Whyte as Mechanical Engineer of that road. Mr. Thompson held this position for a number of years until his appointment to a similar position on the Northern Pacific about two years ago under Mr. E. M. Herr, then Superintendent of Motive Power.

Mr. L. L. Smith, Foreman in the Motive Power Department of the Burlington at Streator, Ill., has been appointed Master Mechanic of the Northwestern Division of the Chicago Great Western, with office in St. Paul. He succeeds Mr. David Van Alstine, who was recently promoted to the position of General Master Mechanic. Mr. Smith has the advantage of a technical education added to excellent experience in the mechanical department of the Burlington. He has made a specialty of the application of piece work to locomotive shops, and for several years was in charge of the interesting brass foundry at Aurora. At that time he prepared for us the paper on the manufacture of phosphor bronze printed on page 147 of our May issue.

Mr. Theo. H. Curtis, Mechanical Engineer of the New York, Chicago & St. Louis, has resigned to become Mechanical Engineer of the Erie, with headquarters at Susquehanna, Pa. Mr. Curtis entered railroad service at Terre Haute in the office of the Superintendent of Motive Power of the Terre Haute & Indianapolis. He took pains during the next few years to learn mechanical railroad work in all of its branches, including the shop, the drafting room and the office of Superintendent of Motive Power. He has also been connected with the Brooks Locomotive Works and the Pittsburgh Locomotive Works. In 1890 he was made Chief Draughtsman of the New York, Chicago & St. Louis, and several years ago was promoted to the position of Mechanical Engineer. He has designed and patented several locomotive improvements.

Mr. Guy E. Mitchell, for a number of years Chief Draftsman in the Motive Power Department of the Boston & Maine, has been appointed Mechanical Engineer and Superintendent of the Locomotive Smoke Preventer Co. of New York, of which Mr. Albert Freeman, 203 Broadway, is General Manager. Mr. Mitchell is a graduate of the Massachusetts Institute of Technology. He began in the shops of the Boston & Maine after graduation and soon after was placed in charge of the drawing room. He worked out the details of the Concord shops of that road, which we illustrated fully last year, and has had charge of other important mechanical engineering work. He is well qualified to improve the combustion of coal in locomotive fireboxes and is a valuable acquisition to the new company whose services he now enters. His successor on the Boston & Maine is Mr. Carl Smith.

Mr. F. M. Whyte has resigned as Mechanical Engineer of the Chicago & Northwestern to accept a position with the same title on the New York Central. He will have charge of the mechanical engineering of the motive power department, including the drafting and experimental work and the testing of materials, both mechanical and chemical. Mr. Whyte is well qualified for the position and the appointment is heartily commended. His experience has been gained in the mechanical department of the Baltimore & Ohio and the Chicago & Northwestern. He was associated with the late David L. Barnes in consulting mechanical engineering work in Chicago, and after the death of Mr. Barnes he opened an office as consulting engineer in that city. Mr. Whyte is widely known from his excellent work as Secretary of the Western Railway Club during the past two years. He appreciates the importance of motive power and car questions and is one of the young motive power officers from whom a great deal may be confidently expected.

McLAUGHLIN'S FLEXIBLE METALLIC STEAM CONDUIT.

This steam pipe connection was developed on the Boston & Maine R. R. by Mr. M. P. McLaughlin for the purpose of avoiding the difficulties of the use of rubber hose in steam connections between locomotives and cars. Rubber hose was very expensive to maintain on account of its short life, and the metallic connection has proved entirely satisfactory after having been in service for two years. An illustrated description of the construction of this conduit was printed on page 376 of our issue of November, 1898. At that time it was in use on the Boston & Maine, but as it has since been put into service on the Chicago & Northwestern, the "Rock Island," the Union Pacific, the New York, Chicago & St. Louis and the Chicago, Milwaukee & St. Paul, it appears to be worthy of further notice.

The joints in the pipe, which is made of steam metal, are made by swiveling elbows, which are packed with vulcanized rubber washers large enough to keep the joints tight and also to provide for taking up wear. There are no springs or loose parts and no ball joint surfaces to maintain. While adapted to a number of purposes requiring flexible connections, such as the hydraulic locomotive hoist at the Boston & Maine shops at Boston (see "American Engineer," May, 1899, page 166), the most severe test has been made in connecting locomotives and tenders for steam heating. It shows itself to wear well without leaking and any form of couplings may be attached to it. It has been found necessary to attach some forms of metallic conduits very nearly in line with the draw bar connection, but we are informed that this is not necessary with the conduit under notice. Interesting and valuable experience was reported concerning a certain form of metallic steam conduit at the recent convention of the Master Mechanics' Association, a portion of which, applying to all forms of flexible metallic conduits, we reproduce as follows :

The Comparative Efficiency and Economy of Metal Flexible Joints Versus Rubber Hose for Steam-heating Connections.

Mr. A. W. Gibbs (Pennsylvania R. R.).—I have availed myself of some records of flexible joints, which we began to use about 1892. At that time the maintenance of connections between our engines and tenders became troublesome, on account of the oil which was thrown from the driving wheels, and it gave us a great deal of trouble by destroying various kinds of flexible hose which were not adapted to resist the action of oil and heat. We finally adopted flexible metal joints, which we now use wherever we have to convey steam between engines and tenders. I find that since 1893 we have bought about 2,900

McLaughlin's Conduit South Union Station, Boston.

joints, for 750 engines altogether, being equipped on all of the lines. There appear to have been about 25 failures from various causes. These joints are now used entirely for the purpose mentioned, partly because they resist the action of oil, which destroys other material, partly because there is no possibility of bursting, which is very awkward on a through train, where you cannot afford to stop, and partly because in our steam heating system we have to carry very heavy pressures between the engine and tender, in order to operate a vacuum pump. Oridnarily you do not have to carry much more than 40 lbs., unless you are running a dynamo in the baggage car; but we are practically running a separate engine all the time on our passenger trains, because we have a vacuum pump in our tender. While the first cost is greater, there are places where you cannot afford to have a failure even at the expense of greater first cost; that is, you can afford to pay a considerable amount to avoid failures in certain important places.

Mr. Frank Slater (Chicago & Northwestern).—My experience has been somewhat limited as to the number of these joints in use. The experience we have had has been very favorable. We have had no expenses connected with the joints when properly applied in the first place. In the first engine on which the joints were applied they were placed considerably to the side of the engine, making a great deal of motion when

rounding curves, and they wore out in about six months. Since then they have been placed directly in line with the drawbar, and they show no wear to speak of, and I have every reason to believe they will last a long time.

Mr. A. E. Manchester (Chicago, Milwaukee & St. Paul).—We commenced last fall applying the ——— joint to a number of our passenger engines that haul dynamo trains. We had had a great deal of trouble with hose connections due to the high pressure steam and the excessive motion, with our overhead system between the engine and tender. The experience thus far has been entirely satisfactory with the ——— joint. We have had no failures whatever, and there have been no cases of leakage. We are putting on more of the joints. The question of cost is considerable when compared with the hose connection, but after looking over our record of cost to maintain the hose connection, we came to the conclusion it would be a very good investment. We found that with dynamo trains we were using about 7 or 8 hose a year, to maintain the service between the engine and tender, with occasional delays occurring on the road by the failure of the steam. We believe the ——— joints are very satisfactory. The joints come recommended in such a way that we get a three years' guarantee on them, which of itself is something of an object.

The accompanying engraving was made from a photograph illustrating the application of the flexible metallic conduit to each of the 50 bumper posts in the new South Union Station in Boston. We are informed that this conduit was selected for this purpose as a result of a thorough test of all similar devices now available. It has been applied to each of the 50 tracks which are equipped for heating cars, while standing in the station, and will be used for warming up the cars before the locomotives are attached. The photograph shows the form of the post and the location of the conduit. For the details of the construction of the conduit and its joints the reader is referred to the previous description. Its selection for use at the Boston station is a substantial endorsement.

COST OF HANDLING FREIGHT.

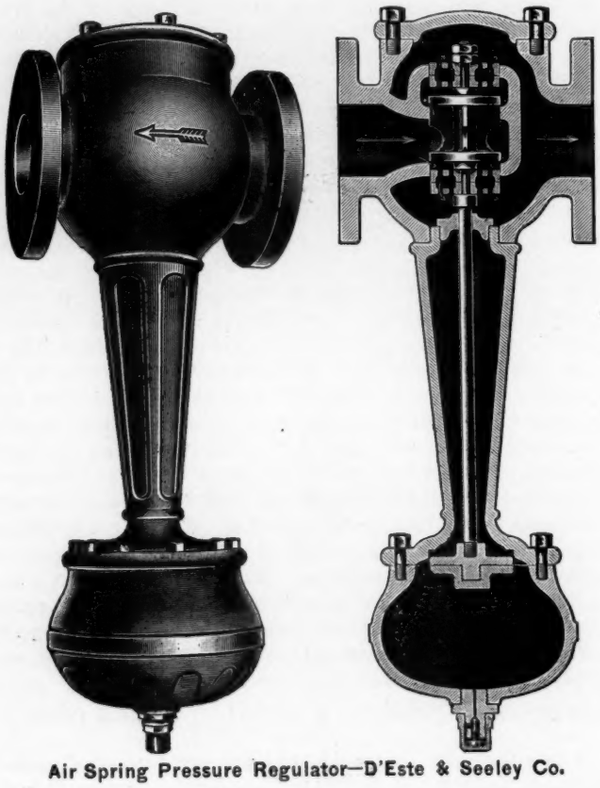
In a recent discussion of the possibility of reducing the cost of handling tonnage, says the "Railway World," General Manager Ramsey, of the Wabash, who is one the most conspicuous advocates of better car loading, remarked that "to increase the trainload you must either increase the weight and power of your engines or decrease your grades. The best way probably is to do both." Both in theory and in practice, however, Mr. Ramsey is striving zealously to realize a third alternative—that of adding very materially to the average amount of freight in each loaded car. The average number of tons freight in each loaded car in each of the last two years on fifteen lines was as follows:

	1898.	1897.
New Haven	9.43	9.34
Erie	14.84	13.94
Southern	11.46	12.30
Louisville and Nashville	13.89	13.16
Illinois Central	12.69	12.51
Wabash	12.99	12.86
Lake Shore	15.41	14.34
Rock Island	15.96	14.46
Northwestern	12.05	10.39
St. Paul	10.94	10.74
Omaha	13.97	13.08
Great Northern	14.75	14.18
Northern Pacific	12.21	10.05
Missouri Pacific	12.50	12.20
Kansas and Texas	11.94	11.71

These averages, of course, are determined by two or three principal factors, such as the prevailing character of the traffic, the physical features and the equipment of the line and the quality of the management. The fact of chief interest is that those representative companies, with a single exception in the last year, helped out their train loads and saved train and car mileage by increasing their carloads. The most striking gains were those of the Northern Pacific and the Chicago & Northwestern.

AIR SPRING PRESSURE REGULATOR.

This device is a pressure regulator or reducing valve which, instead of employing a spring to regulate the pressure, makes use of an air cushion confined in a casing attached to the lower part of the valve. The engraving makes the construction of the device clear. The movement of the valve and consequently the regulation is effected by the pressure of air in the bulb at the bottom of the valve, the pressure being obtained by means of an ordinary bicycle pump. The valve is supported on a flexible metallic diaphragm connected to the valve by a vertical spindle. The air pressure opens the valve and holds it open until the low pressure on the other side of the diaphragm becomes great enough to force it to its seat again. In this way any desired pressure may be secured uniformly by pumping the desired amount of air into the air spring chamber. The valve is double-seated and the device has the advantage of pressure upon both sides of the diaphragm. It is obvious that the fitting for the reception of the pump attachment may be placed at a distance from the air chamber and piped to it if this is desirable on account of the valve being placed in an inaccessible position. The valve is fitted with mufflers and it is stated that its operation is noiseless. This device is manufactured by D'Esté & Seely Co., 29 Haverhill Street, Boston, who state that they have tested it for two years with marked success.



Air Spring Pressure Regulator—D'Este & Seeley Co.

USING THE TECHNICAL PAPERS.

In his presidential address before the Master Mechanics' Association, Mr. Robert Quayle, Superintendent of Motive Power of the Chicago & North Western Ry., directed attention to the use of the technical papers. His idea is an excellent one. "We should use the technical papers intelligently. It is a good plan for the head of the motive power department to mark articles and send them to their master mechanics and such other employees as they would deem wise, asking for comments and suggestions. Will not a little work in this direction pay well?"

Sensible advice in the same direction is given to young engi-

neers by Mr. Daniel Royse in a recent contribution to "The Purdue Exponent," from which the following paragraphs are taken:

"If a young engineer is so situated that he can contribute to the technical press as a writer in either of what are here called the first two classes, it will be of distinct advantage to him to do so. He acquires the ability to express himself well; he learns to think straight (or he is quickly found out); he will become known to his future clients. The discussion which may arise on the subject will be at comparatively short range; because publication is not delayed for weeks or months; an inexperienced writer is given a better chance to consider any reply to questions and criticism than is offered in oral debate at a society meeting; moreover, the men who take part in such discussions do so because they are interested in the subject. Lastly, the pecuniary reward is not to be despised.

"As a preparation for his future work a young engineer cannot do better than to become a close reader of the current periodicals which have for their field his chosen profession. Let him follow the discussions and if possible take part in them; in order to do this with credit to himself, he must become familiar with the subject, and having once mastered it will easily recognize it when after a period of eight or ten years that same subject appears again thinly disguised and heralded as something that is really new. Many questions have a way of reappearing at more or less regular intervals, so that the elders of the profession have met most of them more than once."

TEST OF AN OTTO GASOLINE ENGINE.

Prof. L. P. Breckenridge recently made a test of a 10-horse power Otto gasoline engine at the University of Illinois, the results of which are given in the accompanying table and text, for which we are indebted to the "Railroad Gazette." Four tests were made with the engine belted to a Curtis tank pump, being the arrangement commonly used at railroad water stations; in fact, the test was made especially to determine the performance of the Otto engine under conditions similar to those at water stations. One test was also made in which the work of the engine was absorbed by a brake. The results as shown by the following table are unusually consistent:

Date.	May 30, 1899.			June 1, 1899.	
With pump or brake.	Pump.	Pump.	Pump.	Brake.	Pump.
Duration of test, hours.....	2	1 1/3	1½	1½	1½
Indicated horse-power	3.63	3.74	4.65	12.15	4.45
Theoretical horse-power required to pump water.....	0.742	0.896	1.24	*10.52	0.96
Theoretical horse-power required to pump water in per cent. of i. h. p.....	20.47	23.96	26.67	*86.56	21.57
Temperature of jacket water. Deg. F. | Before....	68	69	68.8	63.6	69
Temperature of jacket water. Deg. F. | Af..	117.3	118.6	117.3	118.5	120
Temperature of air. Deg. F. { Room.....	84.5	86.1	88	86.4	86.5
Temperature of air. Deg. F. { External...	79.3	80.9	81	80.6	82
Temperature of exhaust, Deg. F.	405	416	466	796	461
Jacket water, lbs., used per hour	270	342.6	307.2	836	306
Engine, rev. per min.....	309	308.4	309	307	309
No. explosions per min., average	50.9	49.5	57.1	148.3	58
Pump, rev. per min.....	57.0	54	53	....	54
†Head pumped against, ft....	22.7	28.1	41.1	....	30
Water pumped per hr., gals.	7,760.4	7,546.4	7,151.6	....	7,588.2
Gasoline used per hr., gals..	0.534	0.54	0.57	1.183	0.508
Water pumped per gallon of gasoline, gals.	14,533	13,875	12,547	....	14.935
Gasoline per i. h. p. hr., gals.	0.147	0.144	0.122	0.097	0.114
Gasoline per b.h.p. hr., gals.	....	....	....	0.112	....

*Brake horse-power.
**Mechanical efficiency = brake horse-power ÷ indicated horse-power.
†Includes suction lift.

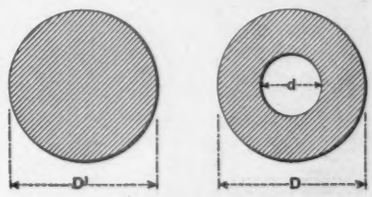
It may be noticed that in the pump tests the mechanical efficiency given is that of the whole plant, taking account of the resistance of the engine, pump and ram, and the pipe friction. The consumption of gasoline per hour in the several tests is seen to vary nearly as the power developed, indicating that the efficiency of the engine is not seriously impaired when working under light loads. The speed in the several tests was maintained fairly constant. Since the tests, this engine has been used by the University to drive a generator which furnishes current for electric lights, and we are informed that the engine is found well adapted to such work.

SHAFTS, HOLLOW AND SOLID.

The appended table of constants, which is reprinted from an issue of "The Engineer" of London, of several years ago, will be found worthy of preservation by those who have to deal with questions relating to the strength and dimensions of shafts. The figures permit the ready determination of equivalent solid and hollow shafts of any dimension, and thus simplifying calculations for strength, deflection, etc., as the ordinary and more general formulæ for solid shafts can be used and the equivalent hollow shaft determined from the required solid one by use of the constants: thus, suppose we are designing a shaft for a given case, which we estimate requires to be 13 inches diameter if solid, and it is desired to reduce weight by making it hollow, then, for a reduction of about 25 per cent. the ratio

$\frac{\text{Inside diameter}}{\text{Outside diameter}}$ (or x in the table) will require to be 0.5.

Estimating on the solid shaft which will be found sufficiently accurate for reductions of weight up to about 30 per cent. thus our 13-in. shaft has a cross sectional area of 132.7 square inches, 25 per cent., of which = 33.2, the area of a 6½-in. diameter hole, so that for a reduction of about 25 per cent. $\frac{d}{D} = \frac{6.5}{13} = 0.5$, the error due to this method being in the present example under 1 per cent. Then from the table, opposite x = 0.5 in the first column read off the corresponding value of C = 1.0218 in the second column, and 13-in. x 1.0218 = 13.2834, say 13 5-16-in will be the required outside diameter of the hollow shaft with a hole say, 6 11-16-in. diameter. Again, suppose the given shaft to be hollow, say 12½-in. external diameter, bored 5⅝, then x = 0.45 the value of K corresponding to which is found in the third column of the table to be 0.986, therefore the diameter of an equivalent solid shaft would be 12.5 × .986 = 12.225-in.



Hollow and Solid Shafts.

Let D^1 = the diameter of a given solid shaft, D the outside, and d the inside diameters respectively of an equivalent hollow shaft; also let D × x = d.

Then $D = D^1 \times C$ and $D^1 = D \times K$, the values of C and K being given in the following table for known values of x. (Calculated by Geo. R. Bale).

x or $\frac{d}{D}$	C or $\frac{1}{\sqrt{1-(x)^4}}$	K or $\frac{D^1}{D}$	x	C	K	x	C	K
0.80	1.1919	0.8382	0.59	1.0440	0.9578	0.39	1.0079	.9920
.79	1.1789	.8482	.58	1.0409	.9607	.38	1.0069	.9930
.78	1.1666	.8571	.57	1.0382	.9632	37	1.0063	.9931
.77	1.1553	.8656	.56	1 0354	.9660	.36	1.0056	.9940
.76	1.1452	.8732	.55	1.0326	.9684	.35	1.0049	.9951
.75	1.1352	.8809	.54	1.0301	.9707	.34	1.0043	.9958
.74	1.1263	.8878	.53	1.0278	.9729	.33	1.0040	.9960
.73	1 1178	.8946	.52	1.0256	.9751	.32	1.0036	.9962
.72	1.1100	.9009	.51	1.0237	.9768	.31	1 0033	.9965
.71	1.1027	.9068	50	1.0218	.9786	.30	1.0026	.9971
.70	1.0958	.9125						
.69	1.0897	.9176	.49	1.0202	.9802	.29	1.0023	.9973
.68	1.0835	.9229	.48	1.0183	.9820	.28	1.0021	.9977
.67	1.0779	.9277	.47	1.0170	.9834	.27	1.0019	.9980
.66	1.0729	.9321	.46	1.0154	.9848	.26	1.0016	.9983
.65	1.0678	.9365	.45	1.0141	.9861	.25	1.0013	.9987
.64	1.0632	.9405	.44	1.0128	.9873			
.63	1 0588	.9444	.43	1.0115	.9886			
.62	1.0549	.9480	.42	1.0105	.9896			
.61	1.0510	.9514	.41	1.0099	.9901			
.60	1.0474	.9546	.40	1.0089	.9910			

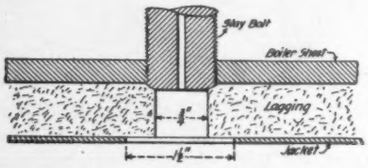
FIREBOX LAGGING FOR LOCOMOTIVES.

Chicago & Northwestern Railway.

The results of the elaborate tests of the efficiency of different locomotive boiler coverings made last winter on the Chicago & Northwestern Railway ("American Engineer," March, 1899, page 76), made such a favorable showing for the general practice of covering about 61 per cent. of the exposed surface with lagging, as to lead to an extension of the covering to the sides and throats of boilers having narrow fireboxes. The advantages of this were obvious, but the difficulty was to provide for the necessary inspection of the stay bolts.

All of the staybolts are drilled with tell-tale holes and wire nails of suitable length are inserted in these holes, after which the sides and throat of the firebox, below the running board, are covered with a plastic covering about ½ or ⅝ inch thick, taking care to have it fit the sheets closely. When this has dried sufficiently the ends of the staybolts are exposed by cutting out the lagging opposite each bolt by means of a circular punch about ¾ inch in diameter. The nails inserted in the holes serve to locate the bolts.

The jacket is of sheet steel about 1/16 inch thick, and it is perforated with holes opposite the staybolts, as shown in the ticable in order to cover as much surface as possible, and those in the jacket are made larger in order to facilitate the sketch. The holes in the lagging are made as small as prac- one on each side and one at the throat. The throat and side sheets are lapped over each other at the front corners of the firebox. The jacket is held in position by a number of ½-inch



Firebox Lagging—C. N. W. Ry.

bolts placed about 16 inches apart. Care is taken to make the jacket fit the lagging as closely as possible.

In this way probably about 80 per cent. of the entire surface of the boiler is protected against radiation, and, according to the tests referred to, this should effect a respectable saving in coal. It was found that when the lagging was extended to the back heads of the boilers the men found the cabs too cold in severe weather, and parts of it were removed. It should be possible to cover the back heads for warm weather and remove enough of the lagging to properly heat the cabs in winter.

We would like to record a plan for lagging the cylinder saddles, and hope this will be the next advance step in this line.

FLANGED VS. "BALD" DRIVING WHEEL TIRES.

One of the many features of locomotive practice on which the opinions of well-informed men is divided is the necessity for omitting the flanges of the middle pair of wheels of a ten-wheel locomotive, and of the second and third pairs of drivers of the consolidation type. The present tendency is toward the use of flanges on all driving wheels, and making an allowance for a little more end play on the journals. A number of roads have discarded plain or "bald" tires altogether and apparently without any sacrifice. The reason is a desire to avoid the expense and trouble incident to carrying plain tires of several sizes in stock. It was regularly practiced in 1860, or thereabouts, by the Rogers Locomotive Works, and the conditions of that time were such that we may raise the question as to why flangeless tires were ever used, even when the 10-wheel and consolidation types came into use. The Master Mechanics' Association has considered this subject several times, and at is most recent appearance at the June conventions of this year the light of present practice was thrown on it by Mr. Henderson and Mr. McConnell.

The former stated that several years ago there were some 10-wheel passenger engines on the Norfolk & Western with bald tires in front and two or three arrangements of trucks for swinging or stationary centres. "We found," said Mr. Henderson, "that rigid trucks seemed to meet with a good deal of a blow when the engines struck a curve. We then changed to swinging centres, and they went around the curves nicely, but there was a good deal of side motion. The restricted swing seemed to be the best arrangement of all. We found the engines would curve more readily and yet the swaying motion would be almost absent, so that a truck with a spring to hold a swing or free centre hanger, to return it very quickly, seemed to be the best arrangement. These arrangements were made with engines having bald tires in front, but later there was some change and flanged tires put in front. American type of engines, 8-wheelers, have been run on a good many roads with swinging centre trucks and flanges on the main wheels; and the 10-wheel engine is not very much different. If we expect to do the guiding by the truck, it is furthest ahead and has the longest lever, and it would seem to be the best place to do the guiding. The truck, so much further ahead, has a longer lever arm, and will receive less resistance than if we put flanges on the front pair of drivers."

The Rome, Watertown & Ogdensburg, the Lehigh Valley, Southern Pacific, Oregon Railway & Navigation Co., Chicago & Western Indiana, Union Pacific, Kansas City, St. Joseph & Council Bluffs and the St. Joseph & Grand Island have, according to Mr. McConnell, all given up the plain tire on 10-wheel, consolidation, and 6-wheel switching types. Mr. McConnell said:

"On the Union Pacific road for the past three years it has been the practice to apply nothing but flanged tires on our consolidation, 10-wheelers and switching engines. The consolidation engines are running on grades of 90 feet to the mile, with a maximum curve of 10 degrees. Our switching engines in the yard are working over 22-degree curves. It is our practice on the consolidation engines to set the two middle tires a total of 3-16 of an inch closer than we do to the front and the back tires. We follow the same practice on the 10-wheelers and on the 6-wheel switching engines. Our experience has been that we have less wear on the front and back tire than we did when the two middle wheels on the consolidation and the middle wheel on the 10-wheeler were bald. The Burlington & Missouri road purchased some consolidation engines last year for service on the Black Hills line. I believe they have grades of 3 per cent. and curves of over 16 degrees. They found that the flanged tires on these engines were a little unsatisfactory and they were obliged to change them, but on the other portions of the road they give very satisfactory service. The advantages, aside from the wear of the tire is that it requires to carry only one class of tire, and that is a flanged tire. On all our engines, as they come to the shop, where they have a blind tire, we turn them up so as to apply a flanged tire."

The use of graphite as a lubricant of engine cylinders is becoming common enough to attract attention to this method of reducing the friction of engines and economizing in the use of oil. The finely ground graphite may be introduced by means of the regular sight feed oil lubricator, or it may be introduced by a small hand pump. We have received records showing a reduction of 12 per cent. in the internal friction of a refrigerating machine obtained by using a hand pump to inject a mixture of oil and graphite into the steam pipe and using a small amount of the same lubricant on the bearings. A saving of 75 per cent. in oil is reported for this plant as a result of the use of graphite. Lubricators are now made which will feed graphite automatically and continuously with the desired uniformity and pass the lubricant through a sight feed glass.

THE "A. B. C." JOURNAL BEARING.

The purpose of this new bearing, which is manufactured by the Atlantic Brass Co., 192 Broadway, New York, is to provide means for transmitting the load to the journals uniformly throughout the length of the journal in order to prolong the life of the brass and prevent heating. To accomplish this the load is transmitted from the box to the brass through a "wedge," which has an adjustable contact with the brass, the surfaces of contact being such as to permit the brass to load the journal uniformly in spite of the tilting and transverse movements of the box.

In the M. C. B. box no provision for self-adjustment is made and the lives of brasses are often very short, because of a concentration of the load at or near one point. This is sure to occur when the truck frame tilts even slightly, and its effect is seen in examining M. C. B. brasses, which very seldom wear uniformly throughout their length.

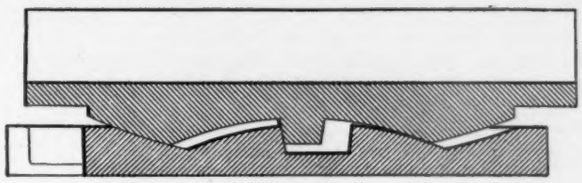


Fig. 1.

The engravings show the self-adjusting surfaces which are ingeniously arranged. The brass has a cavity in the center of its upper face, into which a segment of a sphere on the under side of the wedge fits. The cavity in the brass is slightly elongated for the purpose of giving an easy adjustment of the wedge and the brass. Other spherical surfaces outside of those at the center help to carry the load, and as shown in Fig. 1, they cause the wedge to rise on the top of the brass when subjected to side thrusts, and even under these thrusts the load is carried uniformly to the journal. A projection at the center of the brass passes into an elongated hole in the wedge and prevents excessive side motion due to emergency thrusts. The spherical surfaces bear such a relation to each other as to cause the weight of the car to be raised by side thrusts, causing a tendency to restore the bearings to their normal condition again afterward. Such thrusts are resisted and cushioned by the action of the wedge and the box.

Fig. 2.

A section through the brass is shown in Fig. 3. It is also ingenious and is made in three parts; 3 is the anti-friction bearing metal lining; 2 is the bronze backing for the soft metal, and 1 is a cast steel back, which is strong and stiff and is fused or welded to the bronze part. In earlier forms the bronze part was riveted to the cast steel back, but even moderate heating of a bearing made the rivets brittle and the fusing was devised to overcome that difficulty. The union of the metals when seen in a section of a brass is close and apparently very strong. The cast steel back not only strengthens the structure, making it stiffer than if of solid brass, and therefore less likely to break transversely, but it also reduces the cost.

The brass and wedge when used together will fit the M. C. B. box and the wedge of this adjustable bearing may be used with an M. C. B. brass in the M. C. B. box, so that this bearing will give no trouble on the road whenever a new brass may be required, if an M. C. B. brass is at hand. Experience with these bearings appears to support the claims made for them, and the first cost ought to be much less than that of the ordinary brass. The lubrication of journals ought to be improved by distributing the load uniformly, and it is fair to expect a reduction of train resistance from the smaller amount of friction. It is most important that no change in the boxes is required for these bearings, and also that there is no increase in the number of parts. It is seldom that such a simple device receives the careful study given to this bearing. Some of these bearings have been in constant use in passenger service since November of last year and are reported to be in excellent condition. Other bearings made on this plan, but with riveted cast steel backs, have been in constant service since July, 1897.

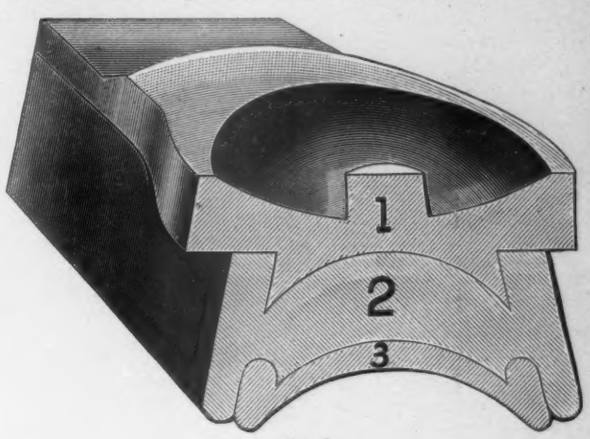


Fig. 3.

PIECEWORK ON THE INTERCOLONIAL RAILWAY IN CANADA.

Establishing piecework and assigning prices is a delicate matter, because of very well understood reasons, and it is particularly difficult to introduce such a system in an establishment which has a large proportion of old employees. Such a situation is seen at the Moncton shops of the Intercolonial Ry. of Canada, and the exceedingly fair method adopted by Mr. G. R. Joughins, Mechanical Superintendent, to place piecework before the foremen is commendable. His circular was printed in the "Railway and Shipping World," as follows:

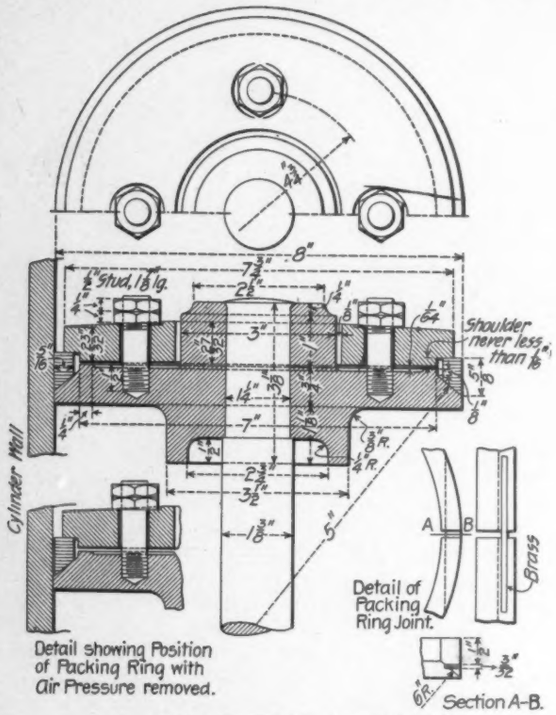
"The management of the Intercolonial wish you to assure all those who will adopt the piecework system, that their desire is to have the work so done and prices so made as to be of mutual advantage, that it be more of a profit sharing than a piecework system, believing that the men have an interest in the prosperity of the road and of the town in which they live. With this end in view each man on piece work will have the full benefit for six months of all improved methods he may use to turn out work, no matter how much wages he may earn within reason.

"On January 1 and July 1 each year prices will be revised to a usual fair and just basis between the men and the railway by mutual agreement. The expectation and object of the management is to see every able-bodied man in its employ busy, prosperous and contented, doing a fair day's work for a fair day's pay or wages. This is not piece work on the ordinary plan, but on a co-operative mutual benefit plan. There will be no unfair crowding to get a lot of work done at cheapest possible rate. No one will be compelled to accept piece work, and

any one may drop it whenever he sees fit to do so, while those who are old and feeble will not be expected to undertake it. There may, of course, be exceptions to the above where there appears to be any glaring mistake. The prices will then be raised on behalf of the workmen, or lowered on behalf of the railway, or cancelled, as may be necessary; the idea being to share the profits of any improved method which may be introduced by the foremen or the men, so as to make it really an industrial partnership."

RAMSDELL'S AIR BRAKE PISTON PACKING.

This packing, designed and patented by Mr. F. H. Ramsdell, has been given a thorough test on the Boston & Maine Railroad with satisfactory results. The construction is clearly shown in the drawing. It consists of a split packing ring having a concave conical or spherical surface, fitting a corresponding surface on the piston head, and the joint in the ring is made tight by a brass connecting piece. The follower plate rests on the upper flat surface of the ring, but does not touch


Stud, 18 lg.
Shoulder never less than 1/16
Cylinder Wall
Detail of Packing Ring Joint.
Brass
Detail showing Position of Packing Ring with Air Pressure removed.
Section A-B.

Ramsdell's Air Brake Piston Packing.

the piston head. The follower plate is in the form of a ring fitting loosely over the hub of the piston head, the opening in the ring being larger than the hub, so that these two parts do not touch.

This arrangement permits the packing ring to be forced out against the walls of the cylinder by the air pressure, the spherical surface acting to open the ring and make an air tight joint with the cylinder. When the pressure is released the ring springs back, as indicated by its position in the engraving, and for this reason there is no friction between the packing and the cylinder during the return stroke. This reduces the wear and eliminates the resistance of the packing in restoring the apparatus to its normal released position. The packing is adapted to all air brake cylinders without necessitating changes in construction, and the old pistons may be used. The function of the ball or spherical joint is to provide automatic adjustment of the packing to take care of wobbling of the piston rod. It is stated that in one case a movement of the rod of ⅜ inch each way from the center, or a total movement of ¾ inch, gave no trouble in the packing and caused no leaking.

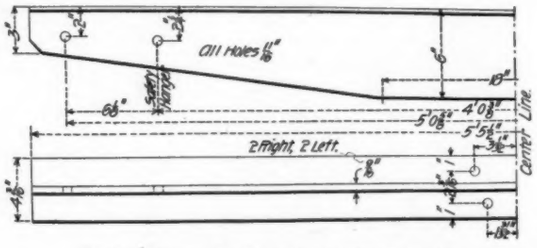
The annoyance occasioned by the wear of leather packing is well understood, and a comparison of the durability of this and leather packing is very favorable to the metallic. Ramsdell's packing has been in constant use in both horizontal and vertical cylinders since October, 1897, and the cylinders and the packing are reported to be in better condition than when first applied, the cylinders are polished and the packing is tight.

In one of these cases the packing was applied to a passenger locomotive in local service and had made 11,584 miles at the time of the test. In two cases the engineer made two reductions of 10 pounds each, the speed being 60 miles per hour. The first was made at a considerable distance from the station and the second near the station. The equalizing pressure was 50 pounds, which is exactly what it should be under these conditions, showing that there was no appreciable leakage. July 1, 1899, the packings were examined again and no wear of the rings was found. As this was a case of local service, with frequent stops, the results are sufficient to demonstrate the practicability of the packing. From the experience on the Boston & Maine this packing is considered as specially valuable when applied to driver brake cylinders which are located near the firebox on account of the heat, which injures the ordinary leather packing in such a location. The road will, however, give it a longer trial before adopting it as a standard for all locomotives. Six locomotives are now equipped with it.

SOUTHERN PACIFIC STEEL BRAKE BEAM.

A steel brake beam made from scrap steel rail has been in use on the Southern Pacific for some time, and we illustrate it by courtesy of Mr. H. J. Small, who kindly furnished a drawing, together with some facts bearing on its manufacture, as follows:

"The old rails are cut to length, heated in a furnace, and the head of the rail is then hammered down to the form as shown in the engraving. A force of five men, consisting of a heater,



Brake Beam Made of Old Steel Rails.
Southern Pacific Ry.

one fireman at the furnace, one hammer man and two men handling the beam under the hammer, produce seven beams per hour. The beams are then taken to the shears and cut to shape, our shear knife being sufficiently long to make the taper cut at each end at one revolution of the shears. We have found this a cheaper process of manufacture than rolling them, from the fact that they require considerable manipulation after leaving the rolls, in the way of straightening out kinks, etc."

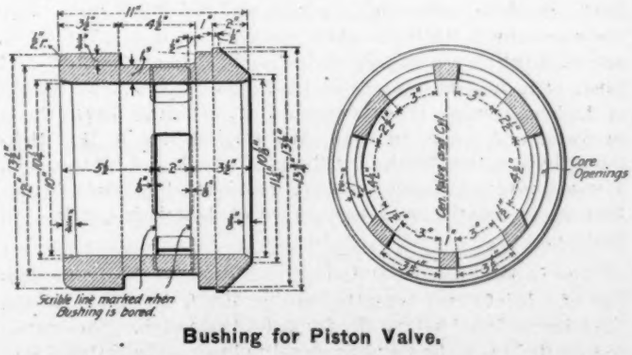
A little calculation will show these beams to be made at a very low labor cost, and, since the material is scrap, it is seen that a good, serviceable brake beam is obtained very cheaply.

Aluminum feeders will be used for the Northwestern Elevated Railroad in Chicago. The order recently placed with the Pittsburgh Reduction Co. calls for 150,000 pounds of that metal, which will be delivered in cables of three sizes, of which the largest will be about 1½ inches in diameter and 10 miles in length. The second size will be 10 miles long and the remainder is smaller in diameter. The cost of the aluminum is about 36 cents per pound, and as about 47 pounds of aluminum is equivalent in conductivity to 100 pounds of copper, which costs 20 cents per pound, the use of aluminum is advantageous.

AN IMPROVEMENT IN PISTON VALVES.

Important advantages have been claimed for piston valves, especially for locomotives with necessarily indirect valve connections. It is desirable to balance the steam pressures to a degree beyond that which is possible with ordinary valves on account of the springing of the valve connections, which tends to reduce the width of the valve opening and prevents the desired amount of steam from entering the cylinders. In some forms of piston valves the packing rings have been made very wide, and, as Mr. F. M. Whyte pointed out in his article on piston valves on page 199 of our June issue, the pressure of steam, which was allowed to get under these rings, set the packing out against the walls of the casing and caused an excessive frictional resistance to the movements of the valves. Mr. Whyte, in the table printed on page 201 of our June issue, shows that the piston valve with wide rings, to which he refers, was not as well balanced as the ordinary D valve of the Chicago & North Western R. R.

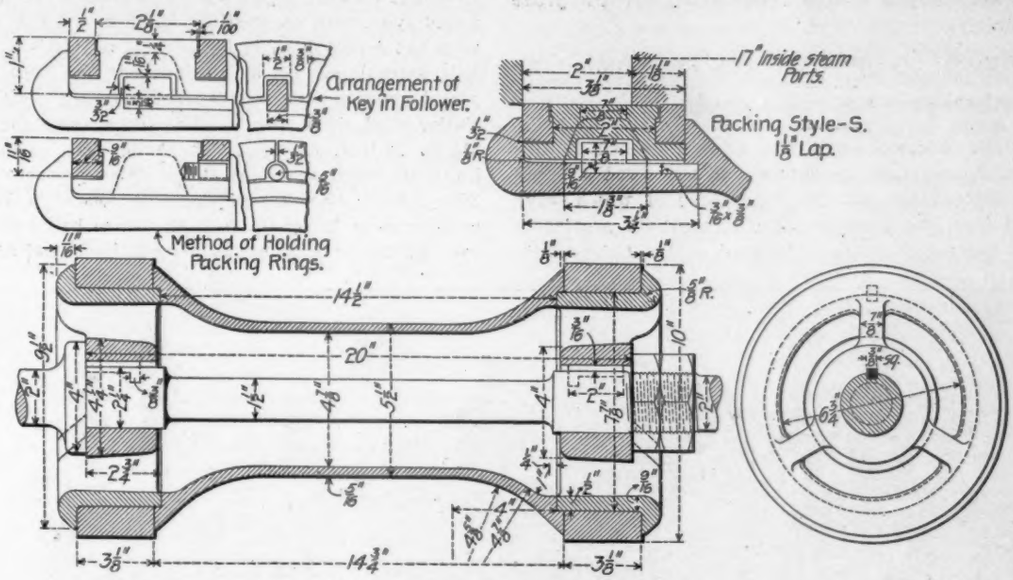
As an appendix to Mr. Whyte's article, we presented an engraving showing the packing rings of the piston valves used in the auxiliary engines in the British naval vessels, and now, by courtesy of the Brooks Locomotive Works, the new piston valves used in locomotives recently built by them are illustrated.



Bushing for Piston Valve.

This arrangement is really the application of the junk ring piston packing to the construction of piston valves, and the Brooks Locomotive Works plan is quite similar to the British Admiralty practice. The joints between the bull rings and the followers are made steam tight, yet they are loose enough to prevent the packing from becoming bound by the follower. These bull rings are, in fact, fitted up in the same way as bull ring pistons. The snap rings are made to fit tight at their lower surfaces in the grooves, but they are not made tight enough to prevent steam from getting under them, because if this were done they would be likely to become bound in the grooves, which would cause trouble. The simple methods of holding the bull ring and the snap rings from turning and also the form of the valve casing are shown in the detail drawings.

This style of packing is being fitted to all locomotives built by the Brooks Works with piston valves. The arrangement of the cylinder and valve chamber is similar to that shown on page 190 of our issue of June, 1898. The reports concerning the operation of the valves in service are favorable, and this form of packing may be expected to give good results.



New Piston Valve Packing.
Brooks Locomotive Works.

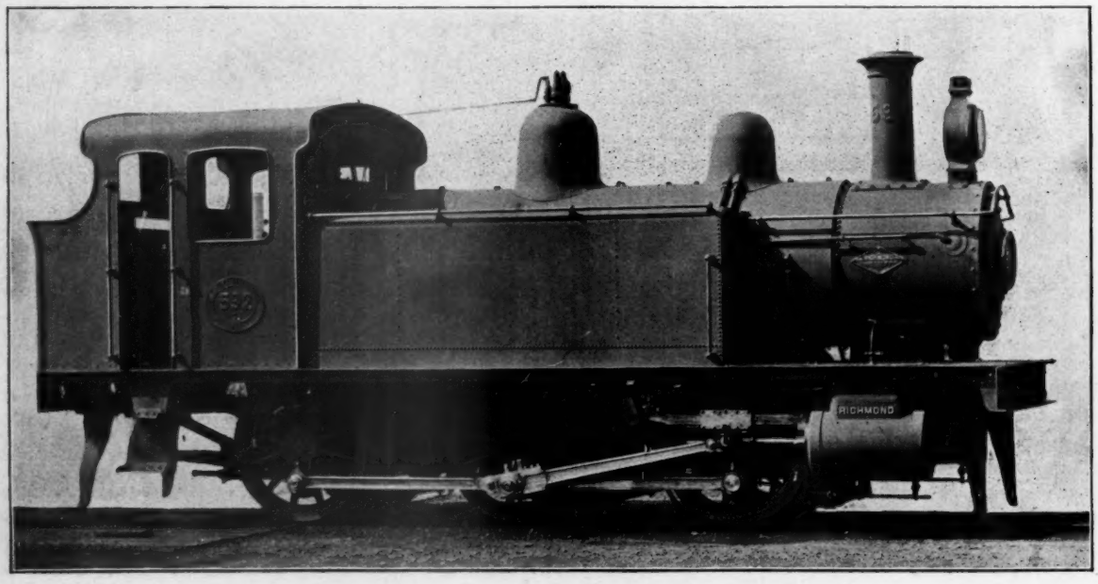
Graphic methods of recording statistics have made much progress during the past few years, and there is much to recommend them. The manager of an important enterprise must be informed at all times as to the condition of the work under him, and if to do so he must study long lists of figures the task becomes so great that his information is imperfect. Figures of the output of a shop, the cost of work done and of the various items going to make up the total, may usually be arranged in curves on co-ordinate paper and these curves by their direction show the tendency of present practice and by unusual changes in direction they show the effects of changes that are made intentionally, or they indicate that some factor hitherto unnoticed is having a marked influence on the results. The men who do not feel helpless when called upon to digest a mass of figures in order to ascertain whether the work of this year is better done than that of the previous year are rare, and graphic records not only afford relief from laborious comparisons, but they also present the comparisons in a way which exhibits relations not otherwise observable. Mr. Tracy Lyon read an instructive paper on this subject before the North West Railway Club some time ago. He has used graphic records for several years, and is enthusiastic about them. In speaking of the ease with which the curves of expenditures for pay rolls may be studied, he said: "The alternative of a pile of dusty old pay rolls, anywhere up to a foot high, is not pleasant to contemplate, and is somewhat hopeless. The diagrams, on the contrary, show at a glance just how many hostlers or car cleaners, for instance, there have been at a given station at any time for years back and just what wages they received. Your attention is immediately and forcibly called to any increase in expenditure by an unmistakable 'hump,' which

shows itself much more prominently than any difference in mere wages. Any change in the distribution or rate of wages is also cleverly shown, this being something which is too easily overlooked with ordinary methods, when there is no change in the total of a certain pay roll." Mr. Lyon uses charts for nearly all locomotive and car records, and finds it worth while to go to the expense of a little extra clerical force in order to put the records in such easily understood form. The inference to be drawn is that he can keep so much better informed of the conduct of his department as to pay for the additional clerical work necessary to draw off the records in this way. It would appear that he needs no argument to prove this to be true.

RICHMOND LOCOMOTIVES FOR SWEDEN.

Six-Coupled, Side Tank Locomotives.

The Richmond Locomotive Works have delivered 10 six-wheel connected, side tank locomotives to the Swedish State Railways, a photograph and the dimensions of which have been received from the builders. The locomotives are interesting chiefly because they are to be used north of the Arctic Circle. They are built to standard gauge and weigh 75,000 pounds on a wheel base of 12 feet. The cylinders are 15 by 22 inches, and are fitted with Richardson balanced valves. The driving wheels are 48 inches in diameter. The diameter of the boiler is 47 inches and the working pressure is 165 pounds. The firebox is 55 inches long by 34 inches wide, and its depth is 59 inches in front and 50 inches at the back. The grate area is 13 square feet and the total heating surface 868 square feet. The tubes are 2 inches in diameter, 10 feet 6 inches long, and the number is 146. The water tank capacity is 1,000 gallons, and the coal capacity 1½ tons. The boiler is fed by two No. 7 "Monitor" injectors. The firebox and water space stay bolts are copper, the other stays being of "Brown" iron. The engines have screw couplings, snow plows, hand brakes and Keasbey & Mattison magnesia sectional boiler covering. With few exceptions the details of these engines are in accordance with American practice, but they are much smaller than modern American locomotives. In these engines the runner sits on the left hand side.



Six-Coupled Side Tank Locomotive—Swedish State Railways.
Built by THE RICHMOND LOCOMOTIVE WORKS.

Compound Ten-Wheel Locomotives.

The same builders have also delivered 10 ten-wheel compounds to the Swedish State Railways, which, with the exception of the absence of bells and pilots, and the use of six wheels instead of eight under the tender, strongly resemble American locomotives. The cab arrangements, like those of the six-wheel connected tank locomotives, are made for the runner to sit on the left hand side of the cab. These engines are to be used in fast passenger service in the southern part of Sweden.

These locomotives, which are much larger than those already described, are also built for standard gauge and for burning coal. The total weight is 122,000 pounds, 87,000 pounds being on the driving wheels. The driving wheels are 62 inches in diameter and the driving wheel base is 12 feet 8 inches. The Richmond system of compounding is used, with cylinders 20 and 31 by 24 inches. The valves are of the Richardson balanced type, with an auxiliary port in the low-pressure valve, after the design described elsewhere in this issue. The driving axle journals are 7½ by 9½ inches. The front end of the engine is carried by a four-wheel swiveling truck, with McKee-Fuller steel tired wheels. The truck axles are of steel, with 5½ by 10-inch journals. The boiler has an extended wagon top with radial stays and the working pressure is 180 pounds. The outside diameter of the first course is 57 inches. The grate area is 19 square feet, the grate being 80 by 34 inches, and the firebox is 65 inches deep in front and 54 inches at the back; the firebox material is copper and the water space stays are also copper, while the other stays are of iron. The tubes, 229 in number, are of iron, 2 inches in diameter and 12 feet long. The heating surface is 1,650 square feet. The weight of the tender empty is 34,000 pounds. It will carry 3,300 gallons of water and 7 tons of coal. We are indebted to the Richmond Locomotive Works for the photograph and information. These compound locomotives are so nearly like those in use here as to constitute an acceptance of American practice in Sweden.

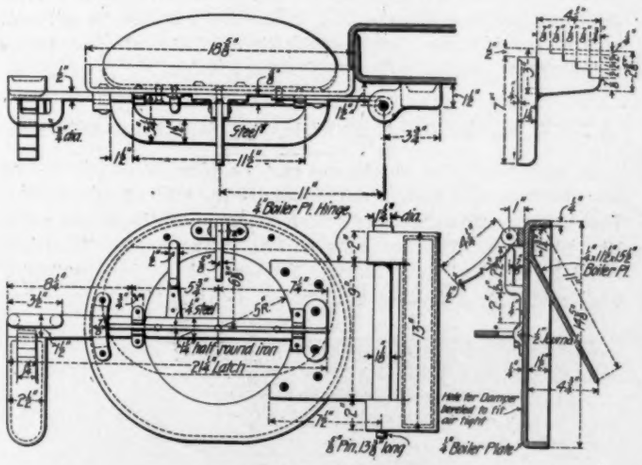
"The Laboratory; Its Relations to a Railroad," was the subject of a brief paper recently read by Mr. J. A. Carney, of the "Burlington," before the St. Louis Railway Club. The author commented upon the peculiar moral influence of a railroad laboratory upon the manufacturer, saying that no implication is made that the manufacturer is dishonest, but he is a little more particular about his product if he knows that it is to be submitted to a careful laboratory inspection. Some years ago it was reported that the laboratory of a certain railroad had been closed. The report was without foundation, but, nevertheless, the manufacturers were under the impression that it was true, and they were not so particular about their products as they had previously been, and as a result more material of all sorts was condemned in a few months than in any two years since the laboratory had been in existence.

PRESSED STEEL FIRE DOOR FOR LOCOMOTIVES.

New York Central.

In describing the new locomotive built by the Schenectady Locomotive Works for the Chicago & Northwestern Ry., on page 188 of our July issue, the fact was noted that the fire doors were made of pressed steel, and that by the use of this material a saving of about 200 pounds in weight was effected. On looking up the design it was found to have been originated by Mr. William Buchanan, formerly Superintendent of Motive Power of the New York Central, from whom we received the drawing before his retirement. The design is in use on that road and an examination of the engraving shows it to be very neat and worthy of attention.

The door itself is 18⅝ by 14⅝ inches in outside dimensions, the form being that of two semi-circles connected with straight lines. The door is pressed into shape from ¼-inch boiler plate, with a flange 1½ inches deep and is carried by a



Pressed Steel Fire Door.
New York Central Railroad.

broad hinge also made of plate of the same thickness and riveted to the door by four ½-inch rivets. The stationary part of the hinge is a casting. At the center of the door a circular hole 10 inches in diameter is cut for a circular damper, the edges of the hole being beveled to fit the damper with an air-tight joint. The damper is hung on horizontal trunnions and a latch at the top permits of fastening it open at the required point for the desired amount of air admission. An internal deflector tends to protect the door from the fire and to direct the incoming air downward toward the fire. The latch bar is of steel and extends across the door. Aside from the saving in weight from the use of pressed steel, the door is noteworthy on account of the very satisfactory regulation of the air admission. The saving in weight may be considered too small to be important, but the fast mail engines referred to embody a number of features in each of which a little weight was saved and the aggregate saving was by no means insignficant. The fact that the heating surface was 2,514 square feet and the weight on driving wheels only 85,700 pounds, shows the extent to which the weight saving was carried. The importance of this, when it makes it possible to put the weight into the boiler, is obvious.

THE STEREOPTICON IN THE EDUCATION OF EMPLOYEES.

The stereopticon as a necessity in the better education and more intelligent training of railroad employees was the subject of a paper read recently before the Central Association of Railroad Officers by Mr. W. J. Murphy, Superintendent of the C., N. O. & T. P. Ry. Mr. Murphy has been very successful in the use of the stereopticon in instructing men and examining them as to their knowledge of their duties, especially in regard to signals. He was led to seek this method because of the difficulties which he had experienced in putting a certain interlocking plant into operation. The situation was complicated by combining the entrance to a busy freight yard; a single track bridge, with interlocking signals; the train staff governing the use of the bridge, and to make matters worse, the usual and correct locations for some of the signals could not be used owing to obstructions, which would prevent them from being seen from a sufficient distance. The rules were carefully illustrated by engravings and were as carefully explained to the men two weeks prior to the date of putting the plant into service. After taking these precautions much damage was done through misunderstanding the indications of the signals, and it was found necessary to assemble the men on the ground and go over the entire plant with them, after which there was no trouble.

Mr. Murphy finds his system advantageous in that the lantern slides virtually bring the men before the actual conditions at such points without going out on the road, and it is possible, by questioning them, to ascertain that they not only understand the signals, but that they see the relation between the signals and the conditions which they govern. The rules in regard to signals may to a certain extent be explained by aid of models, but it is obvious that the particular conditions surrounding signals as they are applied at complicated interlocking plants can not be shown or explained by the general instruction which may be given by means of models. Mr. Murphy explains the advantages of his method in these words:

> By the aid of the stereopticon any existing conditions can be brought into the examining room, not only the signals, but the tracks, the signal towers, the bridge, the bridge signals, the ground itself, so that the employees can see the situation in the examining room as it actually is on the ground, and the examiner is soon able to determine whether the candidates who are being examined fully comprehend the situation.
>
> In the education of trainmen the object desired is not only that they should have a thorough knowledge and uniform understanding of the signals in their various positions, but they should also be taught the relations which a particular signal or appliance has to something else; in other words, they must know definitely the relations existing between a signal and its intimate surroundings. For instance, in the case of a home signal with several arms, one or two of which may indicate proceed: It is not only necessary to know the position indicating proceed, but it is also necessary, in order to proceed as indicated by the signal, to know absolutely the particular track governed by the vertical arm.
>
> The use of the stereopticon develops the knowledge or the lack of knowledge of the employees, not only as to signals, but also as to their proficiency in the train rules generally.
>
> It is, perhaps, well to explain that when an employee is being examined by this method he, and not the examiner, does the necessary explaining. It is his duty to explain what the signals are, where they are, what they govern, what the different positions indicate and what the rules require under the different conditions in the different positions, etc. In this way there can be no question as to the thoroughness of the examination, nor as to the knowledge and understanding of the party undergoing the examination.
>
> Railroad operation is one of the most progressive sciences of the day. The successful operation of a railroad, however, is entirely dependent upon a thorough education of the employees in all the necessary requirements of the rules laid down for their guidance, thereby enabling them to intelligently and successfully apply them in practice.

The Baltimore & Ohio Southwestern is pushing forward its improvements between Parkersburg and East St. Louis; 17,000 tons of 85-lb. rail have already been laid and 25,000 tons remain to be put down, delivery now being slow from the mills. Gravel ballast has been put in on 125 miles, and 200 miles more are to be done this season. The improvements include many grade reductions, and the line is being straightened in several places between Cincinnati and St. Louis. The plan is to reduce the grades between these two points to one-half of one per cent. The work on curves will shorten the line one and one-half miles, 360 degrees of curvature being eliminated. Seven bridges are to be abandoned by filling with earth.

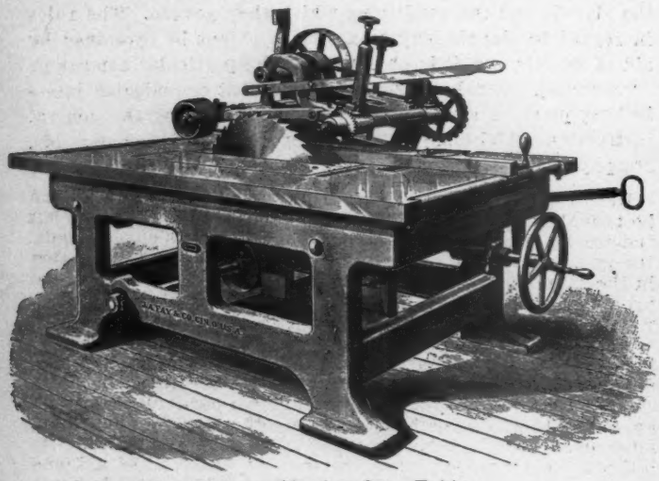
A LARGE SELF-FEEDING RIPPING SAW TABLE.

The machine illustrated by the accompanying engraving is a large, strong and durable ripping saw table with automatic feed, designed with special reference to the requirements of car builders and others who need strong and rapid working machines of this character.

The feed consists of a combination of gearing chain and belts operating a toothed feeding disk, acting on the top surface of the lumber in the same line in which the saw cuts, and a power-driven, fluted delivery roll for carrying the product clear of the saw. It is under perfect control by the hand lever, and can be quickly started or stopped instantly.

The feeding disk and delivery roll may be retained at any desired height from the table by means of hand wheels and screws, and the entire feeding mechanism may be elevated and thrown back out of the way or sustained by a supporting rod, if it is desired to do ordinary ripping. Three speeds of feed—viz.: 47, 84 and 130 feet per minute—are furnished.

The mandrel is of steel, 1⅝ in. in diameter where the saw is applied, and is arranged so that several saws may be used at a time, and by using several feeding disks on the feed shaft, the



Large Ripping Saw Table.
J. A. Fay & Co.

machines will be brought to their full capacity. A long outside bearing supports the driving pulley. Each machine is provided with an improved adjustable fence, which may be instantly fixed at any point.

The table is 78x46 in., made of iron, and has a hand wheel and a raising screw at the front end for raising it in parallel planes. Friction rolls are placed in the table, just below the feeding disk, and a roll to relieve the material from friction. A saw 36 in. in diameter may be used, which will rip material up to 14 in. thick and 21 in. wide.

This machine is the latest product of J. A. Fay & Co., Nos. 516 to 536 W. Front St., Cincinnati, Ohio, and is known as their No. 3, large, self-feeding, ripping sawtable.

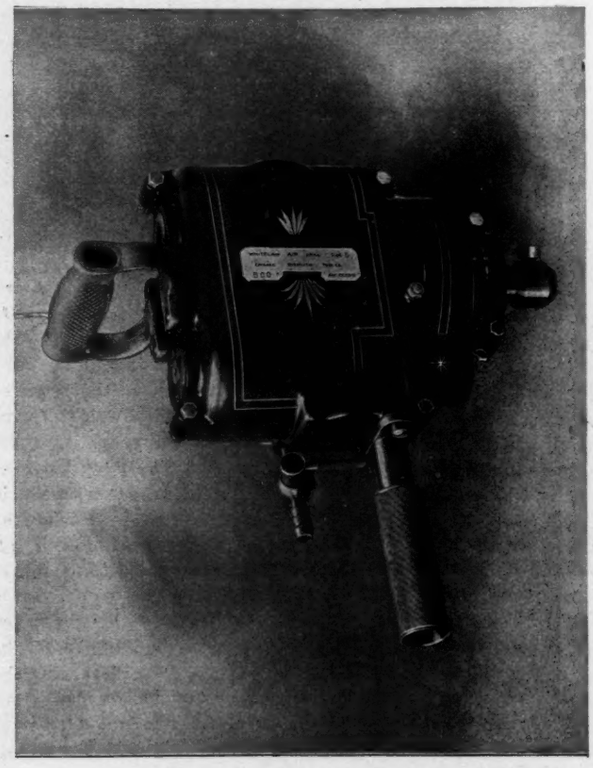
REAMED HOLES FOR LOCOMOTIVE BOILER RIVETS.

It is impossible to take too great care in the details of locomotive boiler construction, in view of the high steam pressures that are now used. The best practice is to ream or drill rivet holes throughout the boiler, and while this is not new, it is well to be reminded of the reasons. Mr. T. R. Browne directed attention to the necessity for smooth rivet holes in his recent remarks before the New York Railroad Club in discussing the subject of locomotive boiler construction. He said:

"It is a mistake to depend on the rough condition of the average punched hole as a finished product for the inserting of rivets. Every hole in the boiler should be reamed, allowing at least ⅛ inch on a side for reaming out; or, in other words, the rivet holes should be punched ¼ inch smaller than their finished size when the rivet is inserted. Bolts should be inserted in every other hole, thoroughly clamping the sheets together and the intermediate holes reamed, and the bolts inserted in the other holes. They should then be taken out and placed in these, the reaming completed, and the last set of bolts left in until the rivets have been driven in the last holes reamed. In connection with the objection to punched holes, we would call attention to just one point which we think will be sufficient, if no other points are brought out to condemn the punched hole. It is a well recognized fact that these holes not only are tapered, but are more or less ragged and irregular on their inside edges. The shanks of iron rivets driven into holes of this kind, will be found to follow the exact contour of the holes, and the fiber of the iron will be found to have a direction which is anything but a straight line. Any tendency to strain the rivet in the direction of its length must, of necessity, first straighten out these fibers before the rivet is in position to resist its maximum stress; in other words, as long as the fiber of this rivet does not follow a straight line, it has not reached its point of maximum resistance before breaking. This is not the case in a straight or reamed hole, for obvious reasons."

A NEW REVERSIBLE PNEUMATIC BORING MACHINE.

An improved light weight and easy running reversible boring machine has just been brought out by the Chicago Pneumatic Tool Co., the appearance of which is shown in the accompanying engraving. This machine will be known as the Whitelaw No. 5 Reversible Wood Boring Machine. It is very compact, convenient for handling and much lighter than the other



No. 5 Whitelaw Boring Machine.
Chicago Pneumatic Tool Co.

Whitelaw tools. It weighs less than ten pounds and yet has sufficient power for boring holes up to three inches in diameter in wood. The machine is provided with ball-bearing throughout, including the crank and piston connections. These bearings are used to reduce the friction of the machine and also to reduce the frequency of lubrication. The machine is reversed

by giving the handle a quarter turn, and it may be reversed while running at full speed. We are informed that it operates equally well when running backward or forward. It is considered a marked improvement over previous tools of this type, and it is understood that those using pneumatic tools, who desire to put this one to a test will be provided with one of them for the purpose upon application to the manufacturers.

Three regular trains running 194 miles without a stop are now scheduled on the Great Western Railway, England, between Paddington Station, London, and Exeter. The fastest of these, according to Mr. Chas. Rous-Marten, in "The Engineer," is timed at 56 miles per hour. The same road runs two express trains from London to Birmingham, 129½ miles, without a stop, and one of them runs at 53½ miles per hour for the trip. Also a train to South Wales is very fast, running from Paddington to Bath, 106 miles, without a stop, at the rate of 54.3 miles per hour.

BOOKS AND PAMPHLETS.

Marine Boilers: Their Construction and Working; Dealing More Especially with Tubulous Boilers. By L. E. Burtin, Chief Constructor of the French Navy. Translated and Edited by Leslie S. Robertson. With a preface by Sir William White, Director of Naval Construction to the British Admiralty and Assistant Controller of the Navy. 437 pages, 250 illustrations. New York: D. Van Nostrand Co., 23 Murray Street, 1898. Price $7.50.

This is a book which every engineer having to do with steam boilers should own.

The author is in responsible charge of the design of the latest French naval vessels and is the best authority on French naval practice, both in naval architecture and marine engineering. Responsibility for these two branches of marine construction is not divided in France, and this book is therefore written with the benefit of the knowledge possessed by both marine engineers and architects. The latter will find important discussions of value in the preparation of designs with regard to properly providing for the steam plant. In the French Navy the water tube boiler has had more attention than it has received anywhere else, and the author treats of the experience very frankly, fairly and exhaustively. The types of boilers are treated individually and the merits and faults of each are plainly stated. The history of each type, its experience and the probable line of future improvement are traced. Sir William White, in his introduction, says that this book presents the best summary yet available, from a French source, of the experience with water tube boilers.

The book had its origin in lectures on Boiler Construction by the author to the future engineers of the French Navy at the "Ecole du Génie Maritime." It was prepared for a special audience and was written because of the lack of a book on the evolution that was going on in boiler construction. The author is not an inventor and is therefore better able to form impartial judgments on the various systems described. The translator has admirably done his part of the work, and the author says that the translation, editing and elaboration of the English edition occupied more time than the original French composition. The editor in his preface comments upon the great amount of attention given to the important question of coal consumption by the French and commends the results of trials recorded in the book to officers of other navies. The translator is to be credited with the index, which is unusually complete and convenient and adds greatly to the value of the book as a reference work. The general divisions of the book are as follows:

The Principal Laws Underlying Steam Navigation; Notation Employed; Short Description of Various Types of Boilers; Brief Description of Marine Engines; Production of Heat from Coal; Liquid Fuel for Marine Boilers; Production of Heat; Tubular Boilers; Locomotive Boilers; General Remarks; Tubulous Boilers; Boilers with Limited Circulation or Coil Boilers; Boilers with Free Circulation; Boilers with Accelerated Circulation; Advantages and Disadvantages of Tubulous Boilers; Comparison of the Different Types; Weight and Space Occupied by the Tubulous Boilers; Boiler Mountings and Other Fittings; Boiler Steam Fittings; Feed Accessories; Accessories Relating to the Disposal of Ashes.

Mr. Burtin has given a large amount of information that has never before been published and has not been available to more than a very few who have enjoyed exceptional opportunities. There is very little of the text book about it, although considerable attention is given to certain of the details of construction. The author's object evidently was to cover principles, but he has not neglected necessary references to the details of construction. The strength of the book lies in the records of the experience of the French Navy in the use of nearly all of the modern types of boilers. These records are freely and frankly expressed in such a way as to inspire confidence that they are the unbiased judgment of one who knows what he is talking about. Some of this information is of the kind that has heretofore been religiously suppressed and held by the manufacturers of the boilers. Various boilers are compared with reference to their ability to make steam, the trouble of maintaining them and their life of service. They are considered under the conditions of long voyages made under the exigencies of naval service.

Water tube boilers are divided into three classes: Those with limited circulation, those with free circulation, and what the author terms accelerated circulation. The Belleville boiler is typical of the first class because of the slight incline of the tubes. The second type is represented by the Babcock & Wilcox, the D'Allest, the Penelle and the Joessel boilers. The Oriolle boiler is mentioned as having been quite successful with coke and other short flaming fuels because of the short distance between the grates and the heating surfaces. The third type is represented by the Yarrow, the Thornycroft and the Mosher boilers. In these the circulation is more rapid than the motion of the steam bubbles through the water. The author has gone into great detail in discussing the advantages and the disadvantages of the different types and he gives a large amount of information the usefulness of which is not by any means confined to marine practice. M. Burtin seems to incline to the opinion that the importance of rapid circulation has been overestimated. He states one of the advantages of the Belleville boiler to be due to the character of its circulation, and this is contrary to the generally accepted opinion.

It must not be thought that the water tube type only is considered. This type is given an amount of attention commensurate with its importance in French practice, and as the French Navy has experimented very extensively in this direction the book owes its chief value to its treatment of this type. The closing chapters are chiefly devoted to the accessories and to the weights and space occupied by the various boilers. The prices paid by the French Government for boilers are stated, and this may be taken as an example of the frankness of the author throughout the work. He does not fail to call attention to the fact that the water tube boiler has serious disadvantages in the relatively small water space and the necessity for the use of pure feed water. The small amount of water that they will hold renders it necessary to watch the feed arrangements with great care. Quite a little space is given to M. Henry's tests on locomotive boiler tubes on the Paris, Lyons & Mediterranean Ry., and such subjects as the advantages to be derived from feed water heaters are discussed. Distillers and ash ejectors are described.

The book is well printed except as to the engravings. These are not good, and they mar a book which is in every other way admirable. M. Burtin has given us an important historical record combined with a very valuable series of comparisons based on a wide experience, and he incidentally offers many suggestions that are worthy of study by those who have to do with entirely different kinds of boilers from those which he treats.

Engine Room Practice. A Handbook for Young Marine Engineers. Treating of the Management of the Main and Auxiliary Engines on Board Ship. By John G. Liversidge, Chief Engineer R. N., London, Charles Griffin & Co., Philadelphia. J. B. Lippincott Co. Cloth, 8 vo. pp. 292. Illustrated. Price, $2.50.

This work is a thoroughly up to date handbook on the prevailing type of vertical marine engine and its accessories in naval and mercantile service. The first impression obtained from it is the great importance of auxiliary machinery in a modern steamship of whatever type, a large portion of the attention of the author having been given to this part of the engineer's duties. The author treats of the discipline, duties and organization of the engineer's force in both naval and merchant service. He goes carefully into the details of the

work in the engine-room in preparing for the voyage, in preparing to get up steam and starting the engines, running them and the boilers and in conducting the voyage. The working of the complex steam plant of a steamship is seen to be extremely complicated and the insight given to the uninitiated into the every-day difficulties of the engine room is a convincing argument for those who have urged the proper recognition of the engineer's force in our navy. A very important part of the work is that which treats of emergency and port repairs to the engines, boilers and auxiliaries. Good use is made of sketches in presenting this subject. The difficulties of keeping steam pipes in order seem to be very great. The chapters on pumps, electric and hydraulic machinery, feed water heaters, evaporators and refrigerating machines present a great deal of information. There are also other parts of the equipment of ships, such as bulkhead doors, valves, piping systems and various fittings which are used by others and maintained by the engine room force. The author also treats the subjects of placing ships in dry docks and duties in harbors, and gives a chapter to Bellville water tube boilers such as are in use by the British Navy. The book is written in clear, concise language. It is well printed with the exception of most of the engravings, and marine engineers and those engaged in building and installing marine machinery will find it valuable and suggestive. It is the only good modern book on this subject that we have seen.

A Primer of the Calculus. By E. Sherman Gould, Member Am. Soc. C. E. Second Edition. D. Van Nostrand Co., 23 Murray St., New York. 1899. Price, 50 cents.

The rapid sale of the first edition of this little book in the Van Nostrand Science Series compelled the revision of the work and it appears on the same lines of the earlier edition, but considerably enlarged. The book gives a development of the infinitesimal calculus as far as the first differentials of algebraic functions of one independent variable and their corresponding integrals. In other words it is confined to the rudiments of the science. The treatment is complete as far as it goes, and no pretension is made for covering the subject completely, the student being left with a clear view of the broadness of the subject. The author states in the preface his opinion that it is better to communicate a working knowledge of the science by teaching a few elementary rules and after this put them into immediate use as far as they will go, rather than to attempt the presentation in any other way. This plan is followed and the remarks concerning the logical basis of the science are reserved for the final chapter. The process is taught first and the reasons why come afterward. This is done to avoid confusing the student with the parts of the theory which are often somewhat perplexing. The student is expected "to pick up a good deal of the doctrine as he goes along." For exhaustive treatment other works are recommended. The chapters are: Differential Calculus, Integral Calculus, Applications of Differential Calculus, Maximum and Minimum Application of Integral Calculus, Applications of Both Combined, Miscellaneous Applications, Limitations, and Additional Examples. A student having a clear idea of the lower mathematics may obtain a working use of the calculus by aid of this carefully written little book, which is specially commended because of the attention which is paid to the practical applications of the science. The presentation is not obscured by the use of the methods of limits. We recommend the work to those who desire an elementary treatise on the subject.

"Snow on the Headlight." A Story of the Great Burlington Strike. By Cy Warman. 12 mo., cloth. D. Appleton & Co., New York. Price, $1.25.

This book is intended to give an interior view of a strike, the locomotive engineers' strike on the "Burlington" in 1888, which was one of the most notable industrial struggles involving a railroad and a labor union. It lasted a year and this book gives a fair and unprejudiced account of much that made it memorable. Every railroad officer and every employee of whatever grade would be less likely to contribute to bringing about a strike if he would read and ponder these chapters. The author shows the real cause of the trouble and presents a view of both sides. In the narrative the sufferings and the terrors of strikes in the homes of the strikers are unmasked and an occasional hot shot is fired at the methods of "The Company." The chief moral is the uselessness of the strike as an institution, and if men preparing to "go out" could be induced to read it they will stop to think before committing themselves. We approve the author's purpose, but those who knew and understood the officers who conducted it, and particularly the one who was in responsible charge, cannot help feeling that the author is taking liberties in that he does not give a history but merely a story founded on a few of the items of the history. It would take several volumes to present a complete account, and that was not the author's intention. The book presents a side of that interesting character, the railroad man, which it is not given to the general public to see, and it will be read with interest by many who have nothing to do with the operation of railroads. The preface is unique and noteworthy. It is as follows: "Here is a decoy duck stuffed with oysters. The duck is mere fiction. The oysters are facts. If you find the duck wholesome, and the oysters hurt you, it is probably because you had a hand in making this bit of history, and in the creation of these facts."

Patents and How to Make Money Out of Them. By W. B. Hutchinson and J. A. E. Criswell, members of the New York Bar. Small octavo, 232 pages, with index. New York: D. Van Nostrand Co., 1899. Price $1.25.

The objects of the authors of this book were to assist those seeking patent protection in using their energies in profitable directions and to enable them to avoid falling into the hands of unscrupulous and incompetent attorneys; in other words, to tell you how to make money out of inventions.

It is elementary in character and treats of the nature and history of patents, as well as the points of patent law which it is necessary for patentees and the purchasers of patents to know. Trade-marks, caveats, copyrights and labels are also included.

In telling the reader what should be patented, this book will be valuable, and the reviewer might have saved the cost of several patents some years ago, if he had the advantage of the sensible suggestions of the authors on "What to Invent." The sale of patents and the function of the promoter are treated. It is specially urged that the first step in taking out a patent should be a thorough investigation in regard to the "state of the art." Many patents are applied for without the least attempt to discover whether the subject is patentable or not. The next step is to consider the probable demand. The book is strongly recommended to coupler inventors and the class who rush blindly into expenses for patents without stopping to think of the most important questions involved. The methods for procedure after deciding these questions are given briefly and clearly.

Western Railway Club. Official Proceedings for the Club Year of 1898-9. Published by the Western Railway Club, Chicago. Pages, 416; standard size (6 by 9 inches). 1899.

Next to the proceedings of the Master Car Builders and the Master Mechanics' Associations, those of the Western Railway Club are the most valuable of the records of the deliberations of motive power organizations, and the appearance of the annual volumes bound in permanent form, which is uniform with those of the other associations mentioned, is heartily commended. The record of the past year's work is worth preservation, and the work is well done and beyond reasonable criticism, with the exception of a mild suggestion in connection with the index at the end of the volume. It is the intention of the club to present members with these volumes at the close of each club year, and people will generally agree with us that this is better than to put the money into banquets. The other clubs will find this idea worthy of consideration. In future volumes it is to be hoped that the subjects discussed will be arranged more conveniently in the index. For example, the paper by Mr. G. W. Scott entitled "Heating Large Railroad Stations and Shops," is indexed under Scott and under Heating, but not under Shops. Handling Sand for Locomotives does not appear under Sand. More thorough cross indexing would improve it. The indexing of the names of speakers is exceedingly complete. The work throughout is creditable to the club and to Secretary Whyte.

Roper's Engineers' Handy Book for Steam Engineers and Machinists. Revised and enlarged by E. R. Keller and C. W. Pike. Fifteenth edition. Published by David McKay, 1022 Market St., Philadelphia. 1899. Price, $3.50.

This edition of "Roper" is revised so thoroughly that it might as well have a new name. It contains a vast amount of information which will be valuable especially for those in charge of steam plants and other machinery, including electric generators and motors. The editors have included material which in most cases may be found elsewhere, but in this collection it is well adapted for the men who will consult it most frequently.

The consideration of materials and their strength and the transmission of power is quite elaborate for a work of this kind and the portion devoted to electricity covers 120 pages. It is a compact and sensible treatment of the principles of the use of electricity, the measurements of current, electric generators, motors, accumulators and the telephone. This portion of the book was written by Mr. Clayton W. Pike, ex-President of the Electrical Section of the Franklin Institute. In addition to the electrical section the book contains a new chapter on gas and gasoline engines. We desire to commend the use of large type and also the appearance of the book generally.

Proceedings of the Railway Signaling Club; 1897-1898. Published by the Club. Edited by the Secretary, C. O. Tilton, C., M. & St. P. Ry., West Milwaukee, Wis. Paper; 8 vo.; 130 pages.

The proceedings and papers with their discussions for the past two years have been published in pamphlet form. The earlier proceedings which have been published in the railroad papers are not included. The volume before us includes the constitution, list of members and rules recommended by the club for the operation and maintenance of interlocking plants. This is probably the most important work of the club, as it embodies the opinions of the men who are in position to know the requirements of operation and maintenance. Among the papers the following are the most important: "The Derail as a Moral and Physical Agent in Safe Railway Travel," by Chas. Hansel; "Successful Automatic Signals," by V. K. Spicer; "The Signal Department," by W. H. Elliott; "The Operation of Block Signals on a Single Track Railway," by W. A. D. Short; "Some Interlocking Devices," by A. H. Rudd; "Should One or Two Wires Be Used for Wire Connected Signals?" by Henry M. Sperry.

The Short Line War, by Merwin Webster; 12mo., cloth, pp. 334; illustrated. The Macmillan Co., 66 Fifth Avenue, New York. Price, $1.50.

The author has succeeded in making a very readable novel out of a railroad fight in which a trunk line unsuccessfully attempts to seize a short line. The various characters are well drawn and there is no lack of incident. Indeed, the plot is highly exciting and interest is well sustained.

There is too much that is of the technical, however, to be pleasing to many superficial readers, and hardly sufficient accuracy and exactness in detail to satisfy the professional. Probably it will find readers chiefly among those who wish for entertainment along somewhat unusual lines.

Light and Power Installations for Private Residences and Hotels.—A most artistically prepared book has been issued by Messrs. Westinghouse, Church, Kerr & Company, New York, entitled "Light and Power Installations for Private Residences and Hotels." It is an advertising pamphlet well worth examination. The finest tinted paper, profuse and original illustrations, and a choice blending of colors, combine to present a business publication in a luxurious setting, coupled with the most refined taste. The pages are illustrated with artistic views of private residences and hotels where electric lighting is provided by Westinghouse gas engines and generators. We note that well-known people have substituted electric lighting for gas and lamps: Mr. Louis Marx, Alexandria Bay, N. Y.; Mr. W. Luttgen, Linden, N. J.; Mr. A. S. Apgar, Ridgefield, Conn.; Mr. Geo. J. Gould, Lakewood, N. J.; The Kirkwood Inn, Scarborough Beach, Maine; Mr. D. Le Roy Dresser, Oyster Bay, N. Y., and many others. We glean from the pages of this interesting book that electric lighting can be supplied in any remote point.. The Westinghouse gas engine is a novel invention, specially adapted for electric lighting. Gasoline may be used as fuel when gas is not available. With an electric plant, light is supplied for the house, stables and grounds; and also power for operating pumps, elevator service, ventilating fans, lathes, saws, preparing fodder, ice freezers, dairy, laundry, and other work connected with private residences and hotels.

Record of Recent Construction, Baldwin Locomotive Works, No. 13.—This pamplet in the valuable series issued by the Baldwin Locomotive Works was prepared to facilitate the various mathematical calculations necessarily involved in locomotive practice, the data being arranged in the form of graphic curves from which the desired results may be quickly obtained. The plates present curves for obtaining the number of revolutions of various sized driving wheels per mile run; piston speed in feet per minute at a speed of 10 miles per hour; the nominal horse-power required for various speeds and grades; tractive power per pound of mean effective pressure, tractive power at 140, 160, 180 and 200 pounds boiler pressure; resistance in pounds per ton of train on various grades and various curves, and hauling capacity of locomotives.

The new illustrated catalogue of The Egan Co., Cincinnati, Ohio, is the most elaborate in its line that we have seen. It is 12½ by 9½ in size, and contains 340 pages. It is printed on fine enameled book paper, suitably bound in cloth, and lettered in gold. The introduction is not only in English, but is also printed in Russian, French, German and Spanish. This company have been endeavoring for several years to perfect and improve their line, so as to make it far superior and in advance of any other machinery, and they have brought out quite a number of new and advanced types of machines. This new catalogue shows all of these new machines and many more, so that no superintendent who wishes to keep in touch with the latest devices for turning out work can afford to be without one. The firm sends out these new catalogues, free of charge, express prepaid, and our readers are invited to write for them to J. A. Fay & Co., 516 to 536 West Front St., Cincinnati, Ohio.

Pneumatic Tools.—The Chicago Pneumatic Tool Co., 635 Monadnock Block, Chicago, have issued a special catalogue illustrating their exhibit at the recent conventions of the Master Mechanics and Master Car Builders' Associations at Old Point Comfort. This exhibit included all of the well known tools manufactured by this company and several new ones; the catalogue therefore presents the most recent practice. Among the the new devices are the Henrikson flue cutter, long stroke riveters for rivets as large as 1½ inches in diameter, long stroke hammers for heavy clipping on steel plate, the No. 5 Whitelaw reversible boring machine which weighs but 10 pounds and will bore holes as large as 3 inches in diameter in wood, and the Cramp pneumatic rammer, which is used in the foundry of the Cramp yards in Philadelphia.

The Bullock Electric Manufacturing Co. send us a copy of their Bulletin No. 2,534, describing their engine type generators. This pamphlet of 10 pages, 8 by 10¼ inches in size, bears the date of August, 1899, and illustrates the construction of generators designed to meet the requirements of engineers for direct driving from either steam or gas engines or water wheels. These generators are compact and tasteful in outline. The pamphlet presents a detailed description of the features of the machines, the arrangement, the method of winding and the details of construction throughout. The pamphlet also contains line drawings of the generators, with tables of dimensions, speeds of revolution, capacity and weight.

Air Compressors.—The catalogues of the Ingersoll-Sergeant Co. have always contained the information which purchasers desire. A copy of the latest edition, known as the Air Compressor Catalogue No. 33, has just been received. A number of illustrations of important installations have been added, and the new edition includes an exhaustive series of formulas and tables on the flow of air through pipes. This information appears to be very valuable. It is evident that its preparation involved considerable expense, and many users of compressed air will appreciate it. The catalogue is indexed.

The Boston Belting Co. has issued a novel advertising device in the form of a series of pictures printed on a circular card 5 inches in diameter, which may be examined in succession through holes in covering discs arranged to be revolved about a central pivot. The pictures impress the desirability of buying only the best goods that are available, and they point to the losses which will be sustained by using cheap and inferior goods. The "cheap and nasty" plan is always a foolish one and particularly when applied to rubber goods.

Electric Mine Haulage.—A catalogue upon underground electric haulage has been issued jointly by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company. Electric mine locomotives produced by such manufacturers cannot fail to interest all mine proprietors who study economy in operating expenses. The catalogue illustrates and describes the locomotives, and contains tables of dimensions, and of the hauling capacity upon various grades.

EQUIPMENT AND MANUFACTURING NOTES.

The Pressed Steel Car Co.'s pressed steel bolsters have been specified for 500 Illinois Central coal cars, and 200 Swift & Co.'s refrigerator cars, recently ordered.

The Chicago Grain Door Co. has received an order from the Chicago, Milwaukee & St. Paul Ry. for grain doors for 1,000 box cars which are to be built at the West Milwaukee shops.

Mr. G. E. Macklin, until recently Special Agent for the Pressed Steel Car Company, has been made Assistant General Sales Agent, with headquarters in the Empire Building, No. 71 Broadway, New York City.

The Illinois Central is soon to receive from the Brooks Locomotive Works a very large 12-wheel locomotive. The cylinders are 23 by 30 inches, the driving wheels 57 inches in diameter, the total weight, without tender, 218,000 lbs.

Mr. D. L. Markle has been appointed Assistant Manager of the Illinois Car and Equipment Co. He has charge of purchasing supplies and assists in the executive operation of the works. Mr. J. M. Maris is Manager and Mr. S. M. Dix, Treasurer.

The Niles Tool Works Co., of Hamilton, O.; the Pond Machine Tool Co., of Plainfield, N. J.; Bement, Miles & Co., of Philadelphia and the Philadelphia Engineering Works, of Philadelphia, have consolidated under the name of the Niles-Bement-Pond Co., with an authorized capital stock of $8,000,000.

Mr. R. L. Gordon, for a long time with the Fox Pressed Steel Equipment Company, and more recently in the Chicago office of the Pressed Steel Car Co., has been transferred to the Wood's Run (Allegheny) plant of the Pressed Steel Car Company, where he will confine himself chiefly to engineering work.

The Reagan Grate Bar Co., 237 North Front Street, Philadelphia, have recently fitted seven of their Reagan grates to boilers of the Griswold Worsted Co. of that city, who write as follows: "We are burning bituminous coal with practically no smoke, and we do not have to clean fires with your grates. Since they were installed we have cut off one boiler. We consider this wonderfully good work and we are well pleased with our investment." This grate has been adapted by Mr. Reagan to locomotives and it is reported to be giving excellent service on the New York, New Haven & Hartford R. R.

The Babcock & Wilcox Company has sold to the Manhattan Elevated Railway Company, of New York City, the boilers required for its new electric generating plant, which will furnish electric current for operating its entire elevated railway system in New York City. The boiler equipment will consist of 64 520 H. P. Babcock & Wilcox all wrought steel boilers, capable of carrying a working pressure of 200 lbs. per square inch. The boilers will be fitted with Roney Automatic Stokers, manufactured by Westinghouse, Church, Kerr & Co. This is the largest single order ever placed for stationary boilers.

Postal cars are wanted in France. Consul Skinner, writing from Marseilles, July 6, 1899, said:

"I am advised that a project of law has been voted in this country upon the suggestion of the Under Secretary of State for the Department of Posts and Telegraphs, providing for the building of sixty-seven modern postal cars, each 13 meters (42 feet 7 inches) in length. The cars now in use follow a model adopted in 1857, and leave a great deal to be desired. The Government will naturally prefer to have the new cars constructed in this country, but, as the American postal cars have advantages greatly superior to anything known upon the Continent, it may be worth the while of American manufacturers to submit propositions."

The J. G. Brill Co. recently furnished an electric locomotive for use in the works of the Sandusky Portland Cement Co. The weight of the locomotive is 14,000 lbs. It is carried on two Brill trucks especially designed for such service. The locomotive is 19 ft. long and about 4 ft. wide, while the track over which it is to run has a gauge of 2 ft. A small cab is provided for the motorman. The design is very simple. The two trucks and the frame connecting them and carrying the cab is practically all there is to the locomotive. The trucks have cast steel side frames and the truck bolster is supported upon helical springs in such a way as to give considerable side motion.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. has ordered four large consolidation locomotives from the International Power Co. of Providence, R. I. They will have the following dimensions: Cylinders, 22 by 30 inches; 72 inch radial stay boilers; fireboxes 9 feet 11 inches by 3 feet 5 inches; tubes, 376 in number, 13 feet 8 inches long and 2 inches diameter; cast steel driving wheels, 56 inches diameter; tanks, 6,000 gallons capacity; Fox pressed steel tender trucks, and the engines will weigh in working order 190,000 pounds. This firm is also building 5 extended wagon top boilers and 16 Wooten firebox boilers for the Erie. The 22 locomotives for the Wabash are now being delivered and the entire order is expected to be completed early in September.

Mr. Adolph Janssens, of Paris and Brussels, has just returned from a trip to this country, where he purchased nearly $200,000 worth of machine tools for export to France and Belgium. These orders were nearly all placed with Messrs. Manning, Maxwell & Moore of New York. In an interview published in the New York "Commercial," Mr. Janssen said: "Until recently I have confined my individual attention to the importation of English tools, but now I find that the tools made in this country are so vastly superior in every respect that I have decided to deal in American tools exclusively the moment my contracts run out. I shall soon return to this country to extend my trade in American machine tools. I am also anxious to return, so that I may extend my knowledge of American modes of manufacturing and operating various machinery."

The importance and volume of the business of the Pressed-Steel Car Company, entirely apart from the manufacture of pressed-steel cars, is not generally understood. The pressed-steel car is of comparatively recent development, that is, such cars have only been in use about three years. But the manufacture of pressed-steel bolsters, truck frames and centre plates, by the old Fox Pressed-Steel Equipment Co. and the Schoen Pressed-Steel Co., which two, combined, make the Pressed-Steel Car Company, has a history of more than ten years. Figures at hand for the past five weeks show a volume of business during that period above $582,000, apart from car deliveries. The profits on this business are not given out, but its volume would seem to indicate the truth of the company's assertion that it is not far from forty per cent. of the total business done, and sufficient to alone pay much more than the seven per cent. required for the annual dividends on its preferred stock, of $12,500,000.

The rapidity of the introduction of electric distribution of power and the wide field into which it is spreading is indicated by the following partial list of sales by the Bullock Electric Mfg. Co., of Cincinnati, Ohio, during July: Union Depot, Dayton, Ohio, 2 50-K. W. Engine Type Generators; Fuller Construction Co., New York City, 4 50-K. W. engine type generators; Wilson Aluminum Co., Holcomb Rock, Va., 1 60-K. W. belted generator; Warren K. Blodgett, Boston, Mass., 1 50-K. W. belted generator; American Type Foundry Co., Cincinnati, Ohio, 25 slow-speed motors for direct connection to type machines; D. E. Whitton Machine Co., New London, Ct., 1 30-K. W. belted generator; U. S. Government, San Francisco, Cal., 1 30-K. W. belted generator; Pullman Palace Car Co., St. Louis, Mo.; 1 12½-K. W. belted generator, 1 25-K. W. engine type generator; Daily Mail, London, England, 2 50-H. P. printing press equipments, Bullock "teaser control" system; Aldrich Mining Co., Brilliant, Ala. 1 30-K. W. belted generator; Missouri Lead & Zinc Co., Joplin, Mo., 1 20-H. P. motor; Boston News Bureau, Boston, Mass., 1 9-H. P. belted motor to run at a speed of 900 revolutions per minute; Hanover Mfg. Co., Bethlehem, Pa., 1 10-H. P. belted motor; Southern Electric Co., St. Louis, Mo., 1 18½ K. W. belted generator; Vulcan Metal Refinery Co., Sewaren, N. J., 1 17½-K. W. belted generator.